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TROPICAL OPHTHALMOLOGY

BY THE SAME AUTHOR

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TROPICAL OPHTHALMOLOGY

BY

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TO

THE STUDENTS OF THE LONDON SCHOOL OF TROPICAL MEDICINE

PAST, PRESENT, AND FUTURE

THIS BOOK IS DEDICATED

With an expression of the hope that they will appreciate the very considerable labour that has been entailed in writing it for their assistance, and that they will make a return, not only by increased energy in the study of the many little-understood tropical conditions which affect the eye, but also (1) by offering advice, criticism, and information on those subjects dealt with in the book, of which they have first-hand and accurate knowledge; and (2) by sending material of all kinds, pathological, zoological, and botanical, to the author for transmission to experts.

TO

E. C. I. E.

BUT FOR WHOSE UNWEARYING
HELP, THE BOOK WOULD NEVER
HAVE BEEN WRITTEN

PREFACE

So far as I am aware, no one has ever yet written a monograph on Tropical Ophthalmology. Such a task requires the best part of a lifetime of experience, and the majority of those, who have thus qualified themselves, have returned to Europe too climate-wearied to undertake a work of this magnitude. The consequence has been that each fresh student of the subject has had to start almost from the commencement. Such a state of affairs is truly lamentable. It means a waste of time, energy, power, and ability.

So impressed have I been with the need to supply this deficiency, that I have for many years been gathering data for the purpose of writing a book, which might be of service to the surgeon in the Tropics, and especially to the beginner there. These lands furnish an immense field for original research; opportunities are waiting on every hand; clinical material is abundant, and painstaking observation, aided by the compilation of careful records, cannot fail to add to the stock, not merely of knowledge which will be scientifically interesting, but also of that which will prove of value from a clinical point of view. Indeed, the worker in the Tropics has an almost virgin field for labour; the opportunity is given to him of serving humanity in a material and practical way, and incidentally of writing his name indelibly on the records of medicine.

If this book has one paramount object, it is to stimulate the young worker to play a man's part in the far-off lands, to which opportunity has led, or necessity has driven him. With this end in view, every page of it has been written. No attempt has been made to produce a comprehensive textbook of ophthalmology. Such would have been a mere work of supererogation. From first to last I have striven to set forth such knowledge as has been gained by past workers in tropical lands, to make the literature of each subject readily accessible, and to indicate the lines along which it seems likely that advances may be made.

It has been no part of my intention to give a full record of the literature of each and every subject ; that would be impossible, within the limits of any reasonable textbook. What I have tried to do, has been to select with great care those references, which seem most likely to be helpful, and especially those which lead up to a larger bibliography. In this way it is hoped that my work will prove an opening door to those who desire to go, as it is my earnest hope many will do, far beyond it.

I have had another and a very strong motive. The Great War has broken down our so-called "splendid isolation," and to-day tropical disease in many forms has come to make its abode, for a long time at least, throughout the length and breadth of our islands. Its study is no longer of merely academic interest to the general practitioner in Great Britain ; it has become an extremely practical matter, entering frequently and intimately into the business of his everyday life. Never has there been more need to repeat the call, first uttered by our present King—"Wake up, England!" If this book can do something, however little,

to assist that awakening, it will, by that alone, have repaid all the toil with which it has been written.

If, to the critical eye, the work seems full of weaknesses and of omissions, I will hasten to admit to my prospective mentors, that probably not one of them realises its deficiencies so fully and clearly as I do myself. In extenuation, I would plead that the task has been a pioneer one, replete with all the difficulties that surround such work.

My friends have been most generous in advice, help, and assistance, and the list of services that I have to acknowledge is so great that I shall not overburden the preface with it, but shall devote a separate chapter to this topic alone.

In conclusion, if I am able to serve others by the many years of work that I have given to this book, I would ask them to be so kind as to help me in return, by sending me specimens, items of information, or criticisms, as opportunity arises. I would point out to them that *no man* can write a *complete* work on tropical ophthalmology alone, and that items of everyday knowledge to those working in distant parts of the Empire will prove of the greatest value and interest to me in the preparation of a second edition of this work, should one be called for, as I hope it may be. I can assure them that all such assistance will be gratefully acknowledged, and that the fullest publicity will be given as to the source of any information supplied me.

ROBERT HENRY ELLIOT.

54 Welbeck Street, London, W. 1,
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Mr. E. Treacher Collins most generously placed at my disposal the valuable notes, on which his lectures to the students of the London School of Tropical Medicine were founded. I have not hesitated to draw freely on this material.

Lieut.-Colonel H. Herbert has helped me most materially by personal communications, and by contributing a number of photographs and illustrations, which have added much to the interest and completeness of at least one section of the book.

Major Walter Kiep, R.A.M.C., has very kindly supplied me with illustrations of dysenteric iritis, and with much valuable information on the eye complications of dysentery, a subject to which he and his collaborator, Miss Euphan Maxwell, to whom also my acknowledgments are due, have made most important contributions.

Lieut.-Colonel H. Kirkpatrick has most kindly contributed chapters on the Madras Operation for Cataract, and on the Ophthalmoscopic Appearances found in Natives of India. He has also assisted me most liberally by means of personal communications, and by his advice on a number of difficult points. Last, but not least, he has furnished

me with a number of drawings and paintings which only require to be seen to be appreciated.

Dr. Manson-Bahr has relieved me of a considerable responsibility by so kindly writing the article on Filaria bancrofti. He has also helped me with his advice on several other subjects, and has been most generous in allowing me to use a number of illustrations from Manson's *Tropical Diseases*, a work which he is now engaged in re-editing, and which may be looked forward to as a most authoritative exposition of the subject.

Professor Miyashita has generously helped me with the chapter on Beriberi, a disease with whose phenomena he is most intimately acquainted.

Dr. Louis Sambon has very kindly written for me the article on Yaws, and has generously helped me with illustrations from the albums of his beautiful collection of photographs of morbid, tropical conditions.

The Editorial Committee of the *British Journal of Ophthalmology* have very generously allowed me to reproduce a number of illustrations from the pages of *The Ophthalmoscope* and of the *British Journal of Ophthalmology*.

Messrs. J. Weiss & Son have most kindly furnished me with blocks illustrating a number of the instruments described in the book.

R. H. ELLIOT.

CONTENTS

SECTION I

INTRODUCTORY

CHAP.		PAGE
I.	Eye Diseases in Tropical Countries	3
	The Centres for the Distribution of Ophthalmic Relief	4
	Railway Facilities	5
	The Poverty of the People	6
	The Mental Attitude of the People	9
	Suspicion of Foreign Agencies	12
	The Influence of Unqualified Native Practitioners	14
	The Prevalence of Eye Disease	14
	Diet	18
II.	Domestic Remedies and Unqualified Native Practitioners	19
III.	A Dangerous Form of Explosive	29

SECTION II

THE EFFECTS OF EXPOSURE OF THE EYES TO STRONG LIGHT IN TROPICAL COUNTRIES

I.	The Physical Properties of Bright Light	35
II.	Glare Asthenopia	38
III.	Glare Conjunctivitis	49
IV.	Injuries of the Eyes by Lightning	52
V.	Eclipse Blindness	62
VI.	Night-Blindness	75
VII.	Erythropsia and Cyanopsia	87

SECTION III

THE EFFECTS OF EXPOSURE OF THE EYES TO WIND AND DUST IN TROPICAL COUNTRIES

CHAP. PAGE

I. Introductory 95

II Pinguecula and Pterygium 99

III. The Causation of Epidemics of Ophthalmia in the East 108

SECTION IV

INJURIES INFLICTED ON THE EYE BY ANIMALS IN THE TROPICS

PART I.—GENERAL CONSIDERATIONS

PART II.—INJURIES BY FLYING INSECTS

Introductory 121

I. Mechanical Injuries 122

II. Chemical Injuries 124

III. Septic Infection 129

PART III.—CHEMICAL INJURIES BY OTHER ANIMALS

I. Ascaris Poisoning 131

II. Eel's Blood Conjunctivitis 132

PART IV.—INJURIES BY STINGS AND BITES

I. Wasp and Bee Stings 133

II. Mosquito Bites 136

III. Ant Bites 137

IV. Tick Bites 138

V. Injuries by other Poisonous Arthropods . . . 139

CHAP. PAGE
VI. Leech Bites 140
VII. Miscellaneous (Chicken Pecks, Rat Bites, Attacks by Snakes, etc.) 142

PART V.—THE INVASION OF THE LIDS AND EYES BY SMALL ARTHROPODS . . 145

SECTION V

PARASITIC DISEASE OF THE EYE

Introductory 149

PART I.—PLATYHELMINTHES

I. Trematodes 152
II. Cestodes 153

PART II.—NEMATHELMINTHES

I. Filaria Bancrofti 158
II. Loa Loa 161
III. Filaria Inermis 171
IV. Filaria Oculi Humani 173
V. Onchocerciasis 178
VI. Thelaziasis 180
VII. Ankylostomiasis 183

PART III.—ARTHROPODA

I. Introductory 187
II. Ocular Myiasis 191

PART IV.—MISCELLANEOUS

I. Rhinosporidium Kinealyi 200
II. Mycetoma 207
III. Aspergillosis 208
IV. Murmekiasmosis Amphilaphes 210

SECTION VI

THE INDIAN OPERATION OF COUCHING FOR CATARACT

CHAP. PAGE

I. Historical 215

II. The Technique of Couching 218

III. The Indian Coucher and his Habits . . . 222

IV. Statistics 226

V. Pathology 229

VI. Diagnosis 233

VII. Clinical 239

SECTION VII

CATARACT EXTRACTION

Introductory 245

I. Selection of Cases for Operation . . . 246

II. The Preparation of the Patient for Operation . 251

III. Asepsis, Antisepsis, and General Arrangements . 254

IV. Methods of Operating for Cataract . . . 263

V. The Madras Cataract Operation. By Lieut.-Col. H. Kirkpatrick 265

VI. Warnings and Rules 276

VII. The After-Treatment of Extraction Cases . . 280

VIII. The Frequency of Cataract in Tropical Countries . 285

SECTION VIII

DISEASES OF THE CONJUNCTIVA, THE CORNEA, THE LIDS, AND THE LACHRYMAL PASSAGES

Introductory 291

PART I.—DISEASES OF THE CONJUNCTIVA . 293

I. Phlyctenular Conjunctivitis 293

II. Trachoma 295

CHAP. PAGE
III. Some Complications and Results of Trachoma . . 302
IV. Some Results of Various Forms of Chronic Conjunctivitis 307
V. Parinaud's Conjunctivitis 312
VI. Samoan Conjunctivitis 314
VII. Spring Catarrh 316
VIII. Filarial Conjunctivitis 321
IX. A Distinctive Conjunctival Papule . . . 322
X. Miscellaneous 324
PART II.—DISEASES OF THE CORNEA . . 325
I. Superficial Punctate Keratitis 325
II. Filamentary Keratitis 331
III. Herbert's Corneal Plaques 333
IV. Lead Incrustation of the Cornea . . . 336
V. Septic Ulceration of the Cornea . . . 337
PART III.—DISEASES OF THE LIDS . . 341
I. A Rare Form of Subconjunctival Granuloma met with in Central China 341
II. Other Unusual Thickened Conditions of the Lids . 346
PART IV.—LACHRYMAL OBSTRUCTION . 348

SECTION IX

MISCELLANEOUS

I. Anatomical Peculiarities of Dark-skinned Races . 365
II. Glaucoma 367
III. New Growths of the Eyeball and its Adnexa . 377
IV. The Correction of Errors of Refraction . . 383
V. Ophthalmoscopic Appearances in the Tropics. By Lieut.-Col. H. Kirkpatrick, I.M.S. . . . 387
VI. Hospital Management 395

SECTION X

GENERAL DISEASES

CHAP.		PAGE
I.	Beriberi	405
	Epidemic Dropsy	414
II.	Cholera	416
III.	Dysentery	419
IV.	Leprosy	429
V.	Malaria	445
VI.	Quinine Poisoning	461
VII.	Pellagra	473
VIII.	Plague	476
IX.	Smallpox	481
X.	Trypanosomiasis	485
XI.	Typhus	492
XII.	Yaws	497
XIII.	Various General Diseases	500
	Black-water Fever	500
	Dengue	501
	Diabetes	502
	Enteric Fever	503
	Heat-stroke	503
	Sand-fly Fever	505
	The Tropical Relapsing Fevers	505
	Undulant Fever	506
	Yellow Fever	506
	Index	509

LIST OF COLOURED PLATES

PLATE		FACING PAGE
I.	Cataract and Symblepharon	20
II.	Pterygium	102
III.	Pterygia of Both Eyes	104
IV.	Large Cyst in connection with a Pterygium	104
V.	Microfilariæ of the Blood	158
VI.	Epithelioma of Conjunctiva	378
VII.	Dermoid Cyst of Limbus	380

LIST OF ILLUSTRATIONS

FIG.		PAGE
1.	The Manufacture of a Medicinal Preparation	21
2.	Three blinded Children	22
3.	Corneal Opacities due to abuse of Drugs	24
4.	Anterior Staphyloma	25
5.	Section of Eye to show Staphyloma	26
6.	Scotoma from Sun-blinding	63
7.	Eclipse Scotomata (after Ask)	66
8.	Double Pterygium	101
9.	Pterygia of both Eyes	102
10.	McReynolds' Operation, Early Stage	105
11.	„ „ Application of Sutures	106
12.	Operation for Double Pterygium	107
13.	*Sparganum mansoni*	155
14.	*Chrysops dimidiata*	162
15.	*Chrysops silacea*	163
16.	Loa loa, natural size	164
17.	„ female	164
18.	„ male	165
19.	„ posterior extremity of male	165
20.	„ „ „ female	165
21.	*Filaria palpebralis*, male	181
22.	Head of *Filaria palpebralis*	181
23.	*Filaria palpebralis*, natural size	181
24.	„ „ tail of female	181
25.	„ „ embryos of	181
26.	*Ankylostomum duodenale*, natural size	183
27.	„ „ female	184
28.	„ „ male	184
29.	*Necator americanus*, male	185
30.	„ „ female	185
31.	*Dermatobia hominis*	189
32.	„ „ maggot	189
33.	*Rhinosporidium kinealyi*	201
34.	„ „ microscopic section	203

FIG.		PAGE
35.	*Rhinosporidium kinealyi*, microscopic section	203
36.	,, ,, ,, ,,	203
37.	,, ,, ,, ,,	203
38.	Rhinosporidium of Lachrymal Sac, microscopic section	205
39.	Murmekiasmosis	210
40.	Multiple Cutaneous Warts	211
41.	Depression of Cataract	216
42.	Reclination of Cataract	216
43.	Couching, the Anterior Operation	218
44.	Couching, the Posterior Operation	218
45.	The Operation of Couching	219
46.	The Instruments used in Couching	220
47.	Forward Dislocation of Couched Cataract	229
48.	Lens couched through Pectinate Ligament	229
49.	Couched Morgagnian Cataract in Vitreous	231
50.	Couched Lens bound down by Exudate	231
51.	Couched Eye in Process of Shrinking	231
52.	Couched Lens in Front of Vitreous Body	231
53.	The Iris Shadow	247
54.	Author's Cruet for sterilising Drops	255
55.	Author's Tea-pot Irrigator	256
56.	Author's Tray for Irrigation	256
57.	McKeown's Irrigator, during Sterilisation	257
58.	,, ,, ready for use	257
59.	Alcohol Steriliser for Cataract Instruments	258
60.	The Madras Cataract Bandage	260
61.	The Madras Cataract Operation— Laceration of Capsule	266
62.	The Section	268
63.	The Iridectomy	269
64.	Delivery of Lens	271
65.	Irrigation	273
66.	Smith's Lid Control in Cataract Extraction	274
67.	Kirkpatrick's Cataract Goggles	281
68.	Ziegler's Knife	283
69.	Cataract Belt	284
70.	Sequelæ of Trachoma	296
71.	,, ,,	297
72.	Snellen's Eyelid Clamp	298
73.	Operation for Entropion	299
74.	,, ,, parts shown in section	300
75.	*Pannus carnosus*	303
76.	The Sinuous Lid Border	305
77.	Conjunctival Bridge, in section	308

FIG.		PAGE
78.	Conjunctival Bridge, shown by everting Lid	308
79.	Spring Catarrh, palpebral	317
80.	Trachoma	318
81.	Spring Catarrh, bulbar	319
82.	Superficial Punctate Keratitis, Kirkpatrick's Disease	328
83.	The Three Main Forms of Kirkpatrick's Disease	329
84.	Herbert's Corneal Plaques	334
85.	Author's Evisceration Spoon	340
86.	Subconjunctival Granuloma	343
87.	„ „	343
88.	„ „	343
89.	„ „	344
90.	„ „	344
91.	„ „	344
92.	„ „	344
93.	Lachrymal Obstruction	351
94.	Position of Table, etc, in Extirpation of Lachrymal Sac	354
95.	Müller's Retractor	355
96.	Author's Dissector	355
97.	Spindle-shaped Cautery for Nasal Duct	356
98.	Ball-shaped Cautery for Dome of Wound	356
99.	Author's Optico-ciliary Neurectomy Hook	374
100.	Teratoma of Orbit	378
101.	Mickulicz's Disease, front view	379
102.	„ „ side view	379
103.	„ „ showing enlarged accessory lobe	379
104.	Malignant Tumour of Lachrymal Gland	381
105.	„ „ „ „	381
106.	Paraplegic Beriberi	408
107.	Dropsical Beriberi	408
108.	Pestle-shaped Scotoma of Beriberi	409
109.	Perimetric Field of Beriberi	409
110.	„ „ „	409
111.	Results of Bilateral Dysenteric Iritis	423
112.	Progress of Dysenteric Iritis	423
113.	Advanced Nodular Leprosy	432
114.	„ „ „	433
115.	Anæsthetic Leprosy	434
116.	*Simulium nigrogilvum*, imago	474
117.	Yaws	498

SECTION I

INTRODUCTORY

Chapter I. Eye Diseases in Tropical Countries.

The centres for the distribution of ophthalmic relief.

Railway facilities.

The poverty of the people.

The mental attitude of the people.

Suspicion of foreign agencies.

The influence of unqualified native practitioners.

The prevalence of eye disease.

Diet.

" II. Domestic Remedies and Unqualified Native Practitioners.

" III. A Dangerous Form of Explosive.

CHAPTER I

EYE DISEASES IN TROPICAL COUNTRIES

The surgeon who has become accustomed to the nature of his surroundings in a tropical country learns to accept, as matters of his everyday life, things which arrest the attention of visitors from more civilised parts of the world. He is awakened to the privileges of his position by the extraordinary interest such travellers take in what to him have become the routine happenings of an exiled existence. He has forgotten what Kipling, the Poet of Empire, has sung that—

"The strangest things of Kew, are the facts of Khatmandhu,
And the crimes of Clapham chaste in Martaban."

It cannot fail to be of assistance to the young student of ophthalmology in the Tropics, that at the very outset, he should gain a clear comprehension of the influences, which are at work to make his experience different from that of his brother who practises in the West. To most of us, such knowledge has only come as the result of years of slow-won and often painful experience. The object of this chapter is to enable the beginner to start where many of us have left off. He will have to learn much for himself, but he will short-cut many a difficult, devious and dangerous road, if he will be content to learn from those who have passed on before him. For the sake of simplicity, we shall endeavour to tabulate some of the principal influences which are at work in tropical countries to stamp ophthalmic practice there with peculiar characteristics.

The Centres for the Distribution of Ophthalmic Relief

In backward countries these are few and scattered. It is difficult for an English student to realise the condition of affairs in a land, where there is only one well-equipped eye hospital for forty million or more inhabitants, and yet, until quite recently, that was the state of affairs in different parts of our Indian Empire. No one, who has not spent years of his life at work in a tropical country, can form any real conception of the enormous amount of preventable and curable blindness, that lays its sombre shadow over the health, the happiness, and the usefulness of millions of our fellow-subjects; yet, and one is bound to say it, those in authority have done but a bare fraction of their duty in the matter. The present method of selection of the men who hold the highest administrative posts, in India at least, is inimical to the choice of the class of ruler needed in backward countries. To stand well with the "powers that be" is far more important than to take wide and long views of life; to have the reputation of cutting down expenses is more favourable to a man's promotion, than the power to depart from precedent and to think for himself. The consequence is that too many of those, who rise to the top of the tree, are quite unfitted to wield the great power which comes into their hands; they would be far better employed in saving rupees in some comparatively subordinate post. With painfully few exceptions they lack vision, imagination, and independence of thought, and are incapable of inaugurating large schemes, or of departing from the beaten track. Another feature which, in India at least, has disfigured the administration, has been a jealousy on the part of the Civilian Executive of the medical officers. It is to be feared that such conditions are not confined to India, and are common to many of the tropical and subtropical lands we rule. One thing is certain, and that is, that there is a strong need for the awakening of a sense of our medical responsibility as an Empire to the nations we govern, and this, not merely for moral reasons, but for the

lower and perhaps more telling ones of practical finance. According to the latest census, there are 600,000 totally blind persons in India ; this does not include the partially blind, or those going blind ; much of this blindness is preventable, much is curable. The very first means for fighting such a scourge is the multiplication of well-equipped and well-manned ophthalmic hospitals. The need is self-evident, and the parsimony that now prevails is worse than a mistake ; it is a sin against responsibility. These views should be stamped on the imagination of every ophthalmologist, who is striving in distant lands to maintain the honour of the greatest Empire the world has ever known.

Railway Facilities

In tropical countries these are often ill-developed, and the distances which patients have to travel are also very great. To undertake such a journey may necessitate months, or even years, of arrangement. The patient may have to tramp long distances before he reaches the railway. The fare he then has to pay would seem small to us, but to him it may mean the spending of the savings of a lifetime. Many of our patients can never hope to be able to afford the journey a second time. With such it is a case of venturing everything on a single cast. Many of them have never seen a white man, except possibly the few district officials, who rarely inspect their villages. A visit to a large town is then a bewildering experience, contemplated with dread in advance, and looked back on, in after years, as the dazed recollection of a tumultuous dream. The surgeon, who would do his best for these patients, must not be lacking in imagination. He must put himself in their place, and see this great venture of theirs as they see it, sympathising with their hopes and fears, laying himself out to make their undertaking as easy and as profitable as possible, and realising to the full their difficulties, their limitations, and their ignorance. He must talk their language fluently ; he must be willing to spend himself and be spent for their good ; and he must make them feel that

he is a real flesh-and-blood man like themselves, full to the brim of human sympathy, and not, as they are so prone to believe, a white demi-god, or a rigid cog in a cold, metallic, official machine.

The Poverty of the People

This factor is closely related to that dealt with in the previous remarks. When the train from up-country has delivered its batch of patients at the terminus, it is the prayer and hope of these travellers that their troubles may prove to be at an end, and that a fatherly Government will undertake for them in an institution devoted to the purpose. Unfortunately, however, it is just at this point that their troubles may begin, and these demand our careful consideration.

1. Many of the cases will be deemed unfit for immediate operation, especially on account of inflammatory lid conditions. What are they to do if the pressure on the hospital beds is such that they cannot at once be admitted ? Only too often their scanty stock of money will be quickly exhausted, and they will be compelled to return home unrelieved. It is most important to realise the full extent of such a disaster. All the self-sacrifice of the patient and of his family has gone for nothing ; it may be impossible for him ever to return, and he goes back to his home a broken, disappointed man, doomed to life-long blindness. It is therefore imperative that every Eastern eye hospital should have *a system of charitable relief* to enable those, who have to wait on as out-patients, not merely to live, but to keep their health, until the time comes for their admission into the wards of the institution for the necessary operations.

2. In dealing with patients who habitually live near the hunger line, it is important to *feed them up*, if possible, for a few days, *before undertaking any serious operation* on the eye. The rest so obtained is of all the more value on account of the long distances many of them have had to travel, and of the condition of flutter and trepidation in which they arrive. The surroundings of a hospital are

utterly unlike those of their village homes, and the short period of rest and of increased nutrition enables them to settle down, and to become accustomed to their new environment.

3. Then another closely related point : It is not enough for the head of a hospital in an Oriental country to provide the food for his patients ; he must do more, *he must see them fed*. It is a saying of the East that " the eye of the master maketh the ox fat," and on this principle the white man in the Tropics has his horses fed outside his dining-room while he is himself at his meals ; likewise his dogs and his other pets are fed under his own eye. Let him carry this rule of conduct into his hospital ! He can trust his menial staff just as far as his active control runs. If they know that the Superintendent may look in unexpectedly on any meal, or may visit the kitchen, and, if necessary, taste the food himself, without a word of previous warning, they will at least see to it that their exactions on the patients under their care are kept within such bounds as to ensure that their charges are properly fed. Nominally, the menial staff of an Eastern hospital is not dieted at the expense of the institution ; practically, this rule is always honoured in the breach and not in the observance. The Superintendent, who endeavours to interfere with this universal and immemorial custom of the people, will find that he is tilting at a windmill, and the consequences will be disastrous. Even if he gets rid of the whole of his staff on this account, those who replace them will behave in exactly the same way, and will serve him worse. Such habits are ingrained in the people, and it is as impossible to fight against them as it would be to refuse to comply with the tipping system in the West. The wisest course is to recognise the position, and by firm and judicious management to prevent abuse from resulting, and to make sure that the patients are suitably and sufficiently fed.

4. The *imperious demands of the seasons* exercise a strong influence on ophthalmic practice in tropical lands. A very large portion of the population is either agricultural or dependent on agriculture. During the rainfall (monsoon)

seasons, every available hand is wanted for the fields. All work early and late ; there is no talk of an eight hours' day. When the harvests have been gathered in and the dry weather has begun, there is time to think of maladies which in the busier season are ignored. The patient, suffering from any form of eye affection, will seldom travel to headquarters to seek relief, unless some one or more of his relatives can accompany him. He must therefore await their leisure and their convenience, often with disastrous results to his hopes of recovering sight. The indifference of the people to the sufferings of their relatives has often been commented on, and none too charitably. If we would judge them aright, it is essential that we should remember that from the cradle to the grave a large bulk of them live very close to the starvation line. The need to keep body and soul together is paramount, and throws into the shade of relative unimportance many conditions, which we might consider to deserve immediate attention. It is often far easier for the poor villager to shoulder the burden of an extra mouth to feed, than to accompany the sufferer on his journey in search of sight or health. This is a large factor in explaining the existence of the hundreds of thousands of hopeless people, scattered through the towns and villages of Eastern countries, for whom the joy and usefulness of life are past, and who lie submerged in pathetic resignation or tragic despair.

The fact that the tropical ophthalmologist works under the conditions we have been sketching above, has an obvious bearing on his treatment of many of those who come to consult him. He must often perform an operation at a much earlier stage than he would be prepared to do if he were working in Europe. This especially applies to glaucoma and cataract. It may be the one chance of his patient's lifetime, and a case of now or never. He must therefore take risks which, under other conditions, would be quite unjustifiable ; and again, he must perform operations with a prophylactic intention, which he would not dream of undertaking were the patient able to consult him whenever the necessity arose.

The Mental Attitude of the People

Few things strike the Western practitioner as more pathetic than the *blind confidence* of Eastern peoples in "Medicine," spelt with a huge "M." It is illustrated by the attitude of those who visit the out-patient rooms. A man has travelled hundreds of miles to see the great specialist, whose reputation has filtered through dark places to the remote corner of the earth, in which his village lies far-flung in the Eastern sunshine. He has begged or borrowed the means to take him there, or has spent the savings of a lifetime on the journey, and at last he has reached the almost sacred precincts. He is met by officials, his name and many other details are registered; he is marshalled into a line, which fades ahead of him whilst it lengthens behind, until he reaches "the presence" at last. What is his mental attitude as he addresses the surgeon or physician "as his God, his father and his mother"? Is it one of exaltation or of excitement? Far from it! it is much more like that which inspires him when he visits a shrine to which he has travelled to fulfil a vow—a blend of ignorance, fear, confidence and hope, lost, hidden, overwhelmed in the one great idea that so far as he is concerned, his part has been fully played. Has he not come to the man who gives sight like a God? What remains for him to do? Absolutely nothing! So strong is this idea that many of the illiterate patients can only with difficulty be induced to answer questions as to their condition and past history. They often seem to expect the treatment meted out at a Chicago factory; they have entered at one end, supplicants for surgical aid; there remains nothing to be done till the great machine grinds them out "cured" at the other end: "Their's not to reason why." Such an attitude has many advantages to the surgical administrator, but it has obvious drawbacks as well.

From such blind confidence we pass, by an easy stage, to speak of *superstition*, with which indeed it is very closely allied. In the East, most of those who can afford to do so will have their horoscope cast before entering upon any

large undertaking, and will consult an astrologer as to the wisdom of the course they propose to pursue. It is not safe to ignore or to despise the influence of the augur. Should he give an adverse opinion, the patient will either refuse to have an operation, or will postpone it to what he terms a more favourable time, which, being surgically interpreted, may mean a much less favourable time. Again, the astrologer will tell the patient that the operation should be performed at a particular hour. There are certain hours of every day in India which are esteemed highly favourable for the inception of new enterprises, and there are others in which the powers of darkness are reputed to be abroad in such force, that it is most unwise to embark on an undertaking, which their malign influences might wreck. Whilst the tropical practitioner should oppose humbug in all its forms, he must realise the very great importance of having his patients' confidence. If a man thinks he is going to do well, he, consciously and unconsciously, assists his medical man ; whilst, on the other hand, the dread of impending misfortune hanging over a bandage-blinded patient may be productive of the worst possible psychical results. One should therefore always endeavour to meet a patient half-way as to times and seasons. It requires very little tact to get the astrologer to fix as the favourable time for operation that most convenient to the surgeon, and so to ensure that the patient embarks on the wearisome ordeal before him, with his hopes and confidence high. This is the practice of most wise surgeons in the East.

A form of superstition constantly met with, and deserving of much less sympathy, is that in favour of the use of *indigenous drugs*. The objection to them is that the preparations are crude and unstandardised to the last degree. Against the employment of such, the surgeon should steadily set his face. Unfortunately they are still used and advocated by some of those who ought to know better. As an instance of this, may be recalled the case of a patient, who urgently desired that her medical man should use one of these drugs against strong advice given

in consultation. She insisted on doing so in conjunction with the treatment that had been suggested. Later she admitted that the preparation had been useless, but urged in extenuation of the failure that the leaves had been collected in the wrong quarter of the moon. An Indian medical man, with a good Western medical degree, had told her the right quarter, and she meant to try again. Such instances in which men with a Western education are concerned are, one is happy to believe, rare, but the bare possibility of such an occurrence as that mentioned, reveals the black wall of ignorance and superstition with which Western science has to contend in the East.

It is an easy step from a consideration of the influences of superstition to speak of *blackmail*. Both alike are the offspring of ignorance and fear. It takes the average European many years of life in a tropical country, before he realises how wide and deep the practice of levying blackmail has its roots in the hearts of Oriental people. Probably every patient who enters a hospital has to pay his footing with the menial staff. If he does not do so, he may find himself punished in one way or another ; his diet is cut ; the treatment which has been ordered is withheld, or at least he is told it is withheld ; if he wants to get his ordeal over, and so return quickly to his own country, he finds that he is not brought up for operation. Even cruder and more daring forms of tyranny are practised. It is represented to him that some member of the staff, possibly even the senior surgeon himself, demands a gift in money or kind, before he will give his services. To the man who does not know the East, it would seem a simple matter to crush out such practices as these. Such a view of the case only shows an ignorance of the black wall, that shuts the European off from the minds of the backward peoples in whose service he spends his life. Try as he may, he will find it impossible to get any evidence that will inculpate those who are responsible for such practices as these. Long ago, an Eastern bewailed " the prophets prophesy falsely, the priests bear rule by their means, and my people love to have it so, and what will ye do in the end thereof ? " Customs, as

deeply ingrained as those we have been discussing, are not to be easily overthrown. We must recognise that it is impossible to stop a certain amount of levy of blackmail, and that this is especially the case when dealing with those who are as helpless as our blind patients often are; but there is one way in which the surgeon can circumscribe these evils, and that is by getting on friendly terms with his patients. The golden key to success in the East is a knowledge of the language of the people among whom one works. If a man knows that you speak his tongue, and if by a little sacrifice of time and effort you can manage to sit on his bed and talk to him about his village, about his crops, and about his children, he will accord you a measure of trust that will spread far beyond his own personality and experience. He will tell others of the great sahib that cures blindness like a god, and that yet has time for human sympathy. Looked at in the coldest, most cynical and most calculating light, such a reputation is a great asset to any surgeon in the East. If there is one piece of advice which the author would give and repeat to every young surgeon in the Tropics, it would be this: Learn to speak fluently the language of the people for whom you work, study their customs, familiarise yourself with their ideas, and thus develop bonds of sympathy with your patient.

Suspicion of Foreign Agencies

Backward peoples are always suspicious of the intrusion of any foreign influence. Philanthropy, such as has for nineteen centuries been associated with the spread of Christian influences, is totally outside their comprehension. They cannot conceive it as possible that the European may be inspired by lofty and unselfish ideals. Behind every unexpected action in life, they are accustomed to look for an ulterior, and often base motive which prompts it. The consequence is that the pioneer has an uphill struggle, but once he has won through and obtained the confidence of the people, the trust reposed in him is measureless and unstinted. The surgeon whom the district has

learnt to know and to confide in, is to the simple villager "his God, his father, and his mother." It takes time, patience, and steady work for Western skill to win its way to its own, but once it has done so, its representative enters into a kingdom the like of which is unknown in Europe. If his successors will tread in his footsteps, they will find the boundaries of their principality of influence extend every year. Even then, they will only touch a fraction of the people, for the populations with which they deal are vast, and education, of whatever kind, reaches them but slowly. In concluding this topic, we would leave off where all life begins, at woman, the eternal question of all climes and peoples. Mention has been made of the astrologer, and of his influence in deciding whether operation or other treatment should be undertaken. Woman wields a greater, because a more universal, power still. A man will come for himself, or with his child, and seek advice: he will apparently be convinced of its correctness, and will then not infrequently decide that he must seek first "the advice of his women-folk." We may rest assured beforehand that their verdict will be against any form of active treatment, and especially against operation. This is not surprising when we remember the secluded life many of these women live, and their lack of anything that can really be called education. The conditions of the East have determined that the training of females in new ideas should lag far behind that of their men-folk. A strong movement for the uplifting of women is now on foot, and will have great results in the near future. Meanwhile we do not wish to be misunderstood to imply that all Eastern women are alike in this respect, for there are many exceptions. We are speaking of broad tendencies rather than of individuals. Nor would we forget the possibility that not a few of those, who reject Western advice on the ground of "female opposition," are really hiding themselves behind the *sahri* (the equivalent of the petticoat). In other words, they are repeating the history that began with Adam's excuse in the Garden: "The woman tempted me, and I did eat."

The Influence of Unqualified Native Practitioners

This is a subject of such importance that it will demand fuller consideration in more than one of the later chapters of this work, but, for the moment, it will suffice to point out that the influence of these men is twofold : (1) *An active opposition* to the Western practitioner and to all his ways. No lie is too barefaced, no calumny too gross to be used as a weapon in this campaign, in which our opponents have the great advantage that they are themselves *of* the people. They have daily and hourly opportunities of disseminating the poison of falsehood ; they know just the shafts which will rankle most, and they play on the credulity of their dupes to an extent which the uninitiated European would find it nearly impossible to believe. The basest of motives are attributed to us, and our results are travestied in a manner which would be amusing, if the consequences were not so serious. Our real failures are magnified out of all recognition, and others are attributed to us which exist only in the fertile imagination of our slanderers. (2) The ignorance of these men is only equalled by the crudeness and the septicity of their methods. They constantly *provide Western science with a field for surgery* which is absolutely unknown in Europe. One need only cite the custom of introducing irritating drugs into the conjunctival sac for various purposes, the systematic and routine couching of cataracts, and the cruel and destructive use of the actual cautery in lid conditions. To this subject we will return in the chapter already promised.

The Prevalence of Eye-Disease

In tropical countries one meets with a very large amount of eye-disease. So true is this statement, that it may safely be said that very few of the native inhabitants arrive at maturity without having suffered, at one time or another, from some such complaint. The atmospheric and domestic conditions of the Tropics appear to be especially favourable to the growth and dissemination of the

various organisms, which are responsible for conjunctival diseases, with the result that the epidemic seasons come round with unfailing regularity. Needless to say, these epidemics vary in their severity, but they are always bad enough to fill the hospital out-patient rooms for the time being. In the course of such a wave, the author has seen in a single morning, thirty, forty, fifty, or even more fresh cases of catarrhal ophthalmia. At such times, other conjunctival conditions are severely aggravated. When one remembers that the same kind of thing is occurring all over the East, one can see how very difficult it is to form a true conception of the enormous mass of conjunctival disease prevalent in India, Afghanistan, Persia, China, and other parts of the Orient, not to mention Egypt and the broad lands of Africa. On the other hand, the provision of suitable medical aid is, as has already been said, still in its infancy ; the result is that the people resort largely to domestic remedies, many of which are very dangerous. This is a big subject and one to which we shall have occasion to recur in a later chapter.

Again, the factors which are provocative of inflammations of the cornea, uveal tract, optic nerve, and other parts of the eye, are fully as prevalent in tropical countries as they are in Europe, if not more so. In many of these lands, venereal disease of a virulent type is rampant, while the septic foci, which underlie auto-intoxication, are, if anything, more frequently met with than they are in Europe. To mention one cause of many, the septic condition of the teeth and gums of many natives in the East is, to say the least of it, highly provocative of auto-intoxication.

The prevalence of malaria, dysentery, and many other diseases unknown in Europe, adds its quota to the risks which the eye must run in tropical climates. Nor must we forget the relatively enormous numbers of cataracts, glaucomas, lachrymal obstructions, lid troubles and other conditions requiring operative treatment, which the surgeon meets with in his daily round of work. It is immaterial for the present to discuss the knotty question whether this

or that condition, cataract for instance, is relatively more frequent in the Orient than in Europe. The outstanding fact is that it is incomparably more so in the practice of individual surgeons.

The tropical ophthalmologist sees many of his cases at a far later stage than his Western colleague. Malignant tumours of the eye and orbit usually present themselves only when the time for successful operative interference is long past. The most that can then be hoped for from surgery, is to render death less painful and less horrible. The size that many of these tumours attain is astonishing, and the condition to which neglect has reduced them is often revolting. Even when an early diagnosis is made, consent to operation is often refused; the patient is lost sight of for a long period, and only returns when it is too late to do anything. A suspicion of the surgeon's motives, bred of ignorance and fear, is responsible for such calamities. Hyper-mature cataracts are so common that a surgeon, who operates on thirty cases in a morning, may find fully ten of these of the Morgagnian variety. Glaucoma, secondary to intumescent cataract, is so commonly met with that the possibility of its occurrence should always be kept in the forefront of the surgeon's mind. A large number of the cases of primary glaucoma come too late for vision to be saved, and in many of them the most that can be done is to relieve the patient's long-drawn pain. Inflammations of the uveal tract are allowed to run their course unchecked, or else are aggravated by harmful treatment. Occlusion and exclusion of the pupil, *l'iris bombé*, and secondary glaucoma are constantly met with in the out-patient room. Granular ophthalmia, which, if taken in hand at an early stage, should never lead to impairment of vision, is responsible for an enormous amount of blindness in Eastern countries; entropion, ectropion, trichiasis, distichiasis, pannus, and corneal lesions are rife. Septic ulceration of the cornea, especially in association with lachrymal disease, is very common; such cases very often come too late. The frequency, with which lachrymal obstruction occurs in the East, may be gauged by the fact that the author has oper-

ated on thirteen cases of this condition in a single morning, without having finished the waiting list : he had, however, reached the limit of his endurance, and was obliged to defer the rest until another day. Double figures for this operation were a by no means infrequent occurrence on the day set apart for operations on the adnexa of the eye. The habit of moving about at night without lights, the injuries received by members of the large agricultural population in the course of their vocations, scratches from the septic nails of children, and the work of the cataract couchers, all combine to make panophthalmitis an almost everyday occurrence in the wards of a large hospital.

Amongst backward peoples, the correction of errors of refraction occupies a much less prominent place in hospital work than it does in Europe. It is only the comparatively small section of those, who are adapting themselves to Western conditions, who trouble the refractionist. One result of this is to make ophthalmic work in tropical and subtropical countries much more interesting than it is elsewhere. Amongst those who do come for lenses, the conditions found closely resemble those met with in European practice. A constant difficulty, however, is the inability to pay for glasses. This even affects the cataract patients, to many of whom the price of a pair of spectacles is absolutely prohibitive. Another difficulty is, that many of these people, and especially the women, will not wear glasses for fear of their neighbours' ridicule ; the idea is too new to them, and the fact that lenses may raise their vision tenfold, weighs little in comparison with the gibes of their neighbours. Amongst the more advanced classes, and especially amongst those engaged in clerical duties, refraction work in tropical lands is steadily coming into its own. Squint operations are few, for patients will comparatively seldom come for the surgical correction of strabismus. Not a few of those who do come are old men, who wish to marry again, and whose brides are girls. This, at least, is the author's experience.

Diet

A great deal has been written on the influence of diet in tropical diseases, and especially in connection with cataract. It must be confessed that there is comparatively little accurate information on which to found many of the assumptions, which have passed for the current coin of scientific knowledge. Where, for instance, a whole population, or a large section of the population, are vegetarians, it is easy to ascribe many unusual conditions met with in the district or country to the influence of diet. This, however, is a very unsafe course to pursue. The climate, the influence of sun, wind and dust, the habits of the people, the forces of heredity, and many other factors must be taken into account. Even when the population is sharply divided into meat-eaters and vegetarians, and where a morbid condition appears to select one class or the other, it is very necessary to remember that the determining cause may lie outside the influence of diet ; it may have to do with the nature of their homes, or with the selection of the sites of their villages and townships, with their water supply, or with some other influence which is not obvious to the superficial observer. To the man fired with scientific enthusiasm, the Tropics furnish an unrivalled field for original research in the domain of ophthalmology, but, as in every other line of investigation, he must be sure to keep a cool head, to weigh the evidence carefully, and not to assume that the most obvious explanation is necessarily the correct one.

Even now we are far from having exhausted the list of the conditions which stamp ophthalmic disease in the Tropics with peculiar characteristics, but those that remain demand more than a paragraph to do them justice, and will therefore be dealt with separately.

CHAPTER II

DOMESTIC REMEDIES AND UNQUALIFIED NATIVE PRACTITIONERS

It has already been said, that in tropical countries eye-disease is so rife, that very few of the native inhabitants arrive at maturity, without having suffered from some form of ocular complaint; whilst adult life, bringing in its train early degeneration, sources of auto-intoxication and occupational risks, adds largely to, instead of diminishing the dangers incurred in childhood. Even the European inhabitants of tropical countries are prone to eye troubles, in spite of their more favourable environments. The consequence is, that every native household has its domestic remedies, some mild and harmless, some moderately efficacious, and not a few extremely dangerous. It is commonly believed that in India the woman is in a state of slavish subjection, and that she exercises little influence on the lives of her men-folk. Such an idea is the outcome of the superficial observations of visitors of the stamp of Paget, M.P. In sickness and in health, the Indian woman is a factor to be reckoned with, as her sisters are the wide world over. Where doctors are scarcest, her responsibilities are greatest, and she shoulders them with courage and endurance. Most Indian wives and mothers have favourite prescriptions for the treatment of the commoner affections to which their families are liable, and there must be few indeed of them who are not prepared, when occasion arises, to deal with the widely prevalent catarrhs of the conjunctiva. Their remedies are very diverse. Some of them are comparatively harmless; for example, human milk, which, especially when squirted into the eye straight

from the breast, has a high reputation for healing power, and possibly has something to recommend it. Many of the other remedies are much less innocent; but to find the quintessence of danger, we must seek for it, not in the homes of the people at large, but in the "laboratories," if we may call them such, of the amateur village expert. Such specialists are usually old ladies, whose reputation as eye doctors rests largely on their weight of years. The idea that a man of forty must be either a fool or a physician, is far wider spread than the land that gave it birth, and King Charles' witty, if offensive comment, that he might be both, is as true of one country as of another. Certain it is that the expert dame of an Indian village, possesses an ignorance of her subject, as colossal as her confidence in her own powers. Not for her the trivial remedies of the wife and mother! She gathers her herbs "in the right phase of the moon," and compounds them by means as devilish as her intentions are angelic. Far be it from us either to blame or to disparage her. The highest award that the world has known was made to a woman whom many blamed, in the words "she hath done what she could." Doubtless the mercenary side of her profession may appeal to the Indian hag, as it may even to the Western specialist, but we must at least concede that she does her best. Her confidence in her remedies seems unshaken by rude failures, a state of affairs which can only be explained by her colossal ignorance, and her blind fatalism. "It is written on the foreheads of certain of her patients that they are to 'go blind': what can she do to alter the inexorable decrees of fate? Meanwhile, if they will sit down, she will place very precious medicine in their eyes."

Mention has been made of the village laboratory. Its roof is the sky, or possibly a leaf lean-to: its floor is the sun-baked earth, and its tools "the mamoti," or Indian spade, of which Mr. Atkins is reported, in his national insularity, to have said, "What can you expect of a people that dig towards their own bellies?"

In Fig. 1 is seen the process of manufacturing a

PLATE I.

CATARACT AND SYMBLEPHARON.

The adhesion between the lid and the conjunctiva and cornea was caused by an ulceration due to the patient applying irritant drugs to the eyes, thinking that these would lead to absorption of the cataract. The opacification of the cornea is well shown.

(Painting supplied by Lt.-Col. H. Kirkpatrick, I.M.S.)

medicinal preparation. On the back of the mamoti are being prepared, under the influence of fire, one of the very precious pastes or powders of the specialist. The common ingredients of such preparations are the juice of the leaves of the tamarind tree (which is very acid and irritating), the juice of fresh limes (a small variety of lemons), alum, various kinds of pepper, iron filings, human milk, human urine, cow-dung (the cow being a sacred animal), ghee (or clarified butter), and a great variety of other sub-

FIG. 1.—The manufacture of a Medicinal Preparation.

stances. Each savant has a personal recipe for the preparation of his or her choice.

It is not difficult to imagine the amount of harm which can be done to an eye suffering from one or other form of conjunctivitis, by the insertion into the conjunctival sac of one of these very irritating pastes or powders. A most unhappy illustration of the harm done is furnished by Fig. 2, which shows a family of three children, brought by their father from a far-away country district to the Madras Eye Hospital. A few weeks earlier, these children had been

attacked by some form of conjunctivitis; an irritating paste was applied, with the result that five of their six eyes were totally deprived of all sight, while the sixth retained but little vision. The author has seen some sad things during the thirty-six years that he has been a student of medicine, but he cannot remember any that exceeds the pathos of that picture, as he sees it again in memory to-day against a background of Indian sunshine —a tall, thin resigned man, walking at the head of the

FIG. 2.—Three blinded children.

procession of his three blinded children, who clung to the stick he held out behind him, and so followed each other in a line, back to their hopeless home, resigned, submissive, uncomplaining, and crushed. If the tragedy in this case seemed the more terrible, inasmuch as the weight of it beat a whole family to the earth, it is but an illustration of what is happening day after day in many Oriental countries.

And now a word on another abuse of these same pastes and powders.

In India, fevers of various kinds are rife, and not infrequently they run a severe course. To such a case the Indian vaidyan (medical man) is called in, and

if he finds the patient in a comatose or semi-comatose condition, he applies drastic means to restore him to consciousness. Should those means fail, both he and the patient's friends bow to the inscrutable decree of a stern providence. On the other hand, should the patient's recuperative powers pull him through, and consciousness shows signs of returning, despite the well meant but evilly carried out efforts of the expert, the credit for the recovery is claimed by the vaidyan, and unhesitatingly given by the grateful friends. Sometimes the methods, though drastic, produce no permanent ill effects, but there is one custom, as common as it is mischievous, of which nothing too bad can be said. It is that of introducing one of these irritant pastes into the conjunctival sac of a comatose patient, with a view to stimulate the brain by means of the pain thus inflicted, and so to restore the patient to consciousness. It is bad enough to insert such irritants into the eye of a conscious patient, who at once does everything in his power to rid his conjunctival sac of the noxious mass. It is far worse in the case of an unconscious sufferer, who makes no effort to get rid of the dangerous irritants, which consequently lie a long time in contact with his cornea. The latter membrane is frequently so severely damaged that it becomes permanently opaque ; not seldom a portion of the corneal substance sloughs away, leading to protrusion of the contents of the eye, and the possibility of all the appalling consequences which follow so often in the train of such a disaster. Look at the photograph shown in Fig. 3 : this woman carries her history written on her eyes for any intelligent student to read. It is obvious in the picture, that the lower parts of her corneæ were totally destroyed, and replaced by cicatricial tissue ; in this were to be seen the stains left by impacted uveal structures.

It will be understood, from what has already been said, that we have a ready explanation, on physical grounds alone, for the fact that the lower part of the cornea is most severely affected in these cases. A powder, or a stiff paste, will naturally remain in the lower cul-de-sac, and will there

do its work with comparatively little interruption. The vaidyan and his imitators do not, however, confine themselves to pastes or powders. Instead, they sometimes instil into the eye one or another variety of drops, some of which are intensely irritating, whilst others owe their potency for mischief to the organisms they contain. Amongst the latter may be classed human urine. One case stands out promi-

Fig. 3.—Corneal Opacities due to the abuse of drugs.

nently in the writer's memory. It was that of a wealthy and highly-educated Burman, who was advised to wash his eyes with his own urine. He did so, and practically lost the sight of both thereby, for his urine contained gonococci. A similar accident may be met with as a result of washing the eyes with "virgin's urine," a far from uncommon practice. Again, it has been stated by reliable Indian practitioners that many of the midwives make a practice of washing the infant's eyes in the mother's urine immediately after birth. Shades of Credé! Is it possible that an informant was correct when he whispered that such atrocities are not unknown even in the British Isles? One hopes not.

Fig. 4 shows the havoc that irritating and bacteria-laden fluids may wreak upon the eye. It cannot fail to be of interest to pass on for a moment to study the after-results of these forms of treatment as we meet with them in the out-patient room.

Huge staphylomas of the cornea are of very frequent

Fig. 4.—Anterior Staphyloma.

occurrence in the East (Fig. 5). There is something uncanny in the appearance the patient presents. The lids frequently constrict the base of the staphyloma, the anterior portion of which then bulges through the palpebral slit in front of the skin surface. The mushroom-button-like mass weirdly follows every movement of the other globe. Such a phenomenon must be as rare in Europe as it is common in the Orient.

Before leaving the subject of the treatment by Indian remedies of conjunctival diseases, there is a lighter side to which we may turn for a moment. There is an element of irresistible comedy in the serious recommendation that a disease of the eye should be treated by rubbing the sole of the corresponding foot with medicated oil. The effect is

heightened by the explanation that the inunction "brings down the heat from the head." Still more amusing is the prophylactic treatment of presbyopia by burning the excreta of a rabbit to ashes, making a paste by mixing these ashes with butter, and daily rubbing the ointment into the eye.

A method of treating corneal trouble by getting a friend

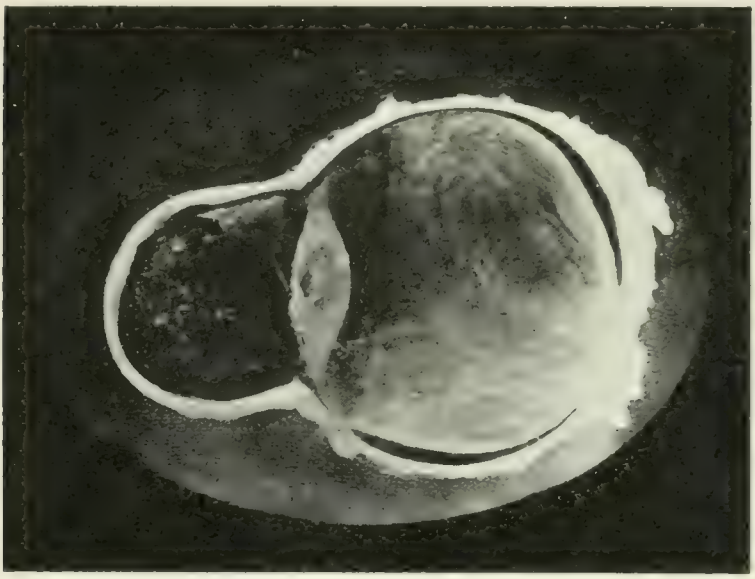

FIG. 5.—Vertical section of an eye to show a huge Anterior Staphyloma.

to chew raw onions, and with his mouth full of the half-masticated mass to blow on to the affected eye is actually in vogue.

The idea is reminiscent of an arrangement which the Madras hospital once obtained from Italy; by means of this, superheated air was blown upon the eyeballs of patients suffering from immature cataract. The distinguished inventor suggested that the maturation of the cataract would be hastened thereby, the principle being that supposed to underlie the formation of glassblowers' cataract. It cannot be said that the "hot air" produced any effect on the cataracts, but it resulted in such an appalling mortality amongst the relatives of the patients subjected to the treatment, that we were constrained to

abandon any further experiments in the same direction. It may be permitted to explain that when an Indian patient desires to change his doctor, he is too polite to state the matter crudely; instead, he slays a relative, preferably a mother-in-law, with his mouth, and hastens away to bury her. Under the same provocation, the Western patient would likewise change his doctor, but he would certainly not show quite so much consideration for the latter's feelings in doing so.

It will be observed, that whereas we began this chapter with a discussion of domestic eye remedies, we have gradually drifted away into a consideration of the procedures adopted by unqualified native practitioners. This was inevitable, for the simple reason that there is not a hard and fast line in the East between the amateur and the expert. The indigenous practitioner is unqualified, and there is no marked difference between him and the more serious of his amateur rivals. On the other hand, operative procedures are kept largely in the hands of those, who devote the whole of their time to the practice of medicine and surgery.

Evidence of past operations on the lids is very common in the Orient. Irregular black streaks in the substance of a scarred palpebral conjunctiva show where an energetic vaidyan, having scraped the part, has rubbed in some form of powder, which has usually been burnt beforehand. Deep elongated scars, running parallel to the lid margin, testify to past cauterisations, made with the red-hot iron, and aimed to secure eversion of the lid edge. Sometimes these are fairly successful, but in a number of cases the cauterisation either fails to produce the desired effect, or else destroys too much tissue with unfortunate results. Deeper and more extensive scars, stretching across the forehead from temple to temple, bear witness to violent and often ineffectual efforts made in the past to secure counter-irritation.

If, however, we desire to study the Oriental operator at his best, or perhaps we should more correctly say at his worst, we must turn our attention to the operation of

couching for cataract. The subject is so important and so fascinating, that we shall devote a section to it, later on in the book. For the present it will suffice to say that these men are ignorant and dirty, and that their methods are crude, filthily septic, and dangerous to a degree.

CHAPTER III

A DANGEROUS FORM OF EXPLOSIVE IN THE EAST

In the closing months of each year, a number of cases of so-called "gunpowder injury" to the eyes are met with in the south of India. These accidents occur mostly at the time of the feasts of Deepavali (Divali) and Karthike, which are commonly spoken of as "cracker feasts." The appearance of an injured eye is most characteristic; it looks as if a number of fine grains of red pepper had been embedded deep in the cornea and conjunctiva; the eyelids and the surrounding skin of the face are similarly studded with the fine red granules. On removing one of these, it is found to consist of red sulphide of arsenic (realgar).

Preparation of the Explosive.—It is illegal to prepare explosives in private houses, but this is nevertheless extensively done. The explosives in common use are of two kinds. In the more dangerous form, red sulphide of arsenic (realgar) and chlorate of potash are mixed in equal proportions by gentle digital manipulation. To this mixture some coarse gravel is added, and the whole is very gently and slowly enclosed in paper; it is next wrapped round with cloth and tied securely. If the "cracker" so made is thrown on the ground or against a wall, it explodes with great violence and with a loud report. If the mixture of the chemicals is made at all roughly, an explosion will take place; but it is after the addition of the small stones or gravel that the risks assume really serious proportions. From what one gathers, accidents are not common in the licensed factories; it is the amateur firework-makers who suffer most frequently. Many of these are fathers of families, who, from motives of economy, break the law on the quiet to provide amuse-

ment for their children. The accidents are apparently most common whilst the men (one never sees a case in a woman) are leaning over, intently watching the explosive mixture which they are making. This explains why the eyes suffer so often and so severely. A much less dangerous mixture is made of two parts of chlorate of potash to one part of sublimed sulphur. This is carried about by boys, and a pinch of it is hammered between two stones, or between a hammer and a stone: an explosion results, but no serious results follow.

Distinctive Clinical Features.—The first impression on examining one of these cases of gunpowder injury, is that the red grains lie quite superficial and should be capable of easy removal. This impression is not confirmed by experience. Very rarely can the particles be picked out with a needle or spud; on the contrary, they are found to be embedded in, and adherent to the tissues, and their extraction is often only possible at the expense of extensive damage to the surrounding cornea; indeed, nothing less than excision of the part will suffice in many cases. Very soon a condition of considerable chemical irritation of the cornea is set up in the more severe cases, and marked circumcorneal injection is found to be present. Later still, chronic iridocyclitis sets in with all its attendant evils, not infrequently culminating in loss of vision and even of the eye. There would appear to be no doubt that all this irritation and inflammation is due to the absorption of the irritating chemical salt, and to its action on the tissues it impregnates. Such absorption is very slow, and the inflammation is therefore very protracted. In rare cases, the grains of realgar are driven right through the cornea and embedded in the lens and iris; in such, the signs of localised iritis and of traumatic cataract soon make themselves manifest. In one case which was treated at the Government Ophthalmic Hospital, Madras, a small rupture of the cornea had taken place close to the limbus; presumably this was due to the force of the explosion. Such a complication is very rare indeed.

Prognosis and Treatment.—There is little to be done.

Where the granules are few and large, they may be laboriously dissected out at repeated sittings; atropin and counter-irritants are used on ordinary lines; but, except in the cases where the original damage is small, the prospect of affording real relief is poor.

Prophylaxis.—Something may be done by an endeavour to disseminate amongst the people a knowledge of the dangers arising from this crude, highly explosive, and chemically irritating form of fireworks, which seems to be in use over a large part of the East.

REFERENCE

Elliot, R. H.—*Opthalmology*, July 1911.

SECTION II

THE EFFECTS OF EXPOSURE OF THE EYES TO STRONG LIGHT IN TROPICAL COUNTRIES

Chapter I. The Physical Properties of Bright Light.

„ II. Glare Asthenopia.

„ III. Glare Conjunctivitis.

„ IV. Injuries of the Eyes by Lightning.

„ V. Eclipse Blindness.

„ VI. Night-Blindness.

„ VII. Erythropsia and Cyanopsia.

CHAPTER I

THE PHYSICAL PROPERTIES OF BRIGHT LIGHT

There are certain elementary facts in connection with the physical properties of bright light, which must be mastered by those who desire to obtain a clear comprehension of the pathological manifestations of the influence of this factor, as met with in the Tropics. We are indebted to Parsons for the clear and valuable manner in which he has set forth what is known on this subject. Bright light includes various manifestations of energy, namely, heat, light, and chemical action.

At the red end of the spectrum we find the vibrations of longer wave-lengths, which are responsible for heat. At the violet end are those of shorter wave-lengths, which cause chemical action. Intermediate between these, both in position and wave-lengths, are the vibrations, which give rise to the phenomena of light.

The visible spectrum consists of vibrations, whose wave-lengths vary from 723 microns at the red end to 397 microns at the violet end. Beyond these lie the ultra-violet and the infra-red rays. A micron is one millionth part of a metre. It must be clearly understood that no rays are exclusively actinic, luminous, or calorific. The actinic rays are slightly calorific, the calorific are slightly actinic, and the luminous are both actinic and calorific.

The absorption of particular rays by a structure of the eye may cause pathologic changes in the tissues, inasmuch as the absorption of the rays is nothing more or less than a transformation of the form of energy they represent.

Certain forms of electric light, especially the arc lamp and the mercury vapour lamp, are very rich in the ultra-violet, chemically active rays.

Absorption by Dioptic Media.—The aqueous fluid, like water, absorbs heat-rays strongly, but has little action on the visible (luminous) and the ultra-violet rays. The cornea offers little resistance to rays of wave-lengths greater than 295 microns, but all below that are cut off. The lens completely absorbs all rays of any wave-lengths less than 350 microns, and a certain number up to 400 microns. The vitreous, even in thin layers, shows a broad absorption band from 280 to 250 microns, with its maximum at 270. The exact limits of absorption by the media of the eye are variously stated by different observers, but the results on the whole are in agreement on all the main points. Absorption by the cornea and vitreous would appear to depend, to some extent, on the age of the subject ; a still more important point is that it is distinctly diminished by debility due to disease. There are several other matters of interest which may briefly be alluded to in turn.

The Conjunctiva.—The intense congestion and inflammation of the conjunctiva, which follow exposure to ultra-violet light from mercury vapour lamps, naked arc-lights, etc., may be prevented by wearing large plain spectacles fitted with ordinary glass, and still more effectually by the use of Crookes' glass. The affection of the superficial structures of the eye by the ultra-violet rays is much more likely to take place in high altitudes, not merely because the snow lies there, and so intensifies the glare, but also by reason of the fact, that fewer ultra-violet rays are absorbed by the rarefied atmosphere, and more of them are consequently reflected from any bright surface on the hillsides.

The Lens is to a great extent shielded from the heat-rays by the aqueous, and from the ultra-violet light by the cornea. The latter only allows those of wave-lengths greater than 295 microns to pass, but the lens itself has a very powerful capacity for absorbing ultra-violet light—a fact which explains its strong fluorescence, when these rays (from 295 to 350 microns) fall on its surface. Various changes in the lens have been attributed to the action of light ; probably the ultra-violet rays above specified are to some extent

responsible, but neither the light nor the heat rays are beyond suspicion.

The Retina.—There has been much misunderstanding and divergence of opinion as to which of the solar rays reach and act adversely upon the retina. Since the aqueous cuts off most of the heat-rays, and the cornea, lens, and vitreous bar the passage of the great majority of the ultra-violet rays, it might be assumed that only the luminous rays are left, at least in any dangerous quantity. It is clear that the removal of the lens must greatly alter the quality of the solar rays which reach the retina, the volume of ultra-violet light admitted being considerably increased thereby. It is, however, believed that the retina, even of the aphakic eye, is sufficiently protected from injury under the ordinary conditions of life by the cornea and vitreous, although an additional protection can be secured by the use of special glasses if necessary. Quite another question arises under abnormal conditions, *e.g.*, when an eye stares at the sun during an eclipse, or still more at other times. The result of the findings from experiments have been contradictory, some believing that the retinal lesions met with are due to the excess of light rays admitted, and others (Verhoeff and Bell) maintaining that it is only when the concentration of light involves enough heat energy to produce definite thermic lesions, that the retina is likely to suffer damage.

Having thus cleared the ground, we are in a position to study a number of pathologic conditions, which are met with in the tropical countries as a result of the over-exposure of the eyes to strong light. We shall deal with each of these in turn.[1]

[1] For References, see end of Chapter III.

CHAPTER II

GLARE ASTHENOPIA

The author has ventured to suggest this term as a convenient label for a very troublesome group of symptoms, which are not infrequently found in patients who have for a long period been exposed to tropical glare.

Clinical Course.—As a rule, the trouble comes on gradually and insidiously. At first there is merely a slight sense of discomfort, whilst the patient is in the sun, and a trifling headache afterwards; but, should these sentinel indications be disregarded, discomfort deepens into pain, and the headaches which follow exposure make the patient's life a misery. He complains bitterly of a disinclination or of an inability to "face the glare," which is steadily growing upon him. When out in the sun he half closes his lids, turns his eyes down, puckers his forehead and face, and, in severe cases, holds up his hand in front of him to shut off the glare. When he reaches the welcome shelter of a house he is often conscious of a neuralgic headache. The balls of the eyes feel hot and heavy, and on gentle manipulation they are found to be distinctly tender to the touch. The conjunctivæ may appear slightly injected, and some lachrymation may be present. The headache, not infrequently, takes peculiar forms, the centre of the pain being referred to a tender spot on some part of the scalp, or at the back of the neck; an interesting point is that this focus of hyperæsthesia may be found to have a constant location in the same patient. A quite favourite seat for it would appear to be the neighbourhood of the occipital protuberance. Unfortunately, the patient's troubles do not end with sunset, for a bright light from a lamp in the room, the glare (as he describes it) of the street lamps, the

flash of the lights of a passing carriage, or even bright moonlight are each and all sufficient to irritate his hypersensitive eyes, and to cause him discomfort and even suffering. Curiously enough, one will find that some of these sufferers do not so much mind a light in front of them, as one that catches them from the side. An oblique illumination appears to be peculiarly irritating to them, doubtless as a consequence of the greater sensitiveness of the periphery of the retina, as compared with its centre, to stimulation by light.

Ophthalmoscopic examination reveals a normal fundus, nor, with the exception to be mentioned directly, is any objective sign of disease to be found in the eye. The patient shrinks from prolonged examination of any kind, especially from such as is attended by the use of strong light. The obvious indication from this is that ophthalmoscopy should be cut down to the necessary minimum ; the information gained by it is usually nil, and the harm it does is very appreciable.

In quite a number of these cases we find evidence of congestion of the retrotarsal folds of the conjunctiva. This is the exception above mentioned. The congestion may be so slight that it can only with difficulty be identified, or it may be sufficiently marked to deserve the title of a conjunctivitis. All intermediate forms occur.

The condition we are discussing has attracted very little notice at the hands of the profession. Indeed, the literature of the subject is very scanty. Many of those who suffer from glare asthenopia complain that, if they consult a doctor, they are apt to be ridiculed and treated as hypochondriacs. This is the more annoying to them, because their sufferings are very real.

No one but a subject of this form of hyperæsthesia can appreciate the misery that the hapless patient may suffer. This point is illustrated by the case of a young English planter in the East who travelled many miles to consult a surgeon. A "careful examination" of his fundus was made, and he was assured that there was "nothing the matter with his eye." Some idea of the despair into which

the loss of his last hope plunged him, may be gathered from the fact that he returned to his estate and drowned himself. The medical man, whose "careful examination" had probably increased his patient's suffering, was disposed to consider the patient's symptoms unreal, until he heard of the melancholy ending of the case. It was only then that he realised that possibly he had made a mistake—an opinion in which there was little difficulty in confirming him.

The following cases from the author's notebook will serve to reinforce the lesson that he desires to teach :

1. A gentleman who had served a long time in India complained that, in his worst attack, which, by the way, was cured by leave to Europe, he was so bad that, when he was on his journey home, the "sight of a white face was enough to pain him."

2. A medical man who suffered from glare, stated that on one occasion when he went home much run down in health, it was painful for him to write on white paper.

3. An elderly gentleman in the Civil Service only began to experience any trouble in the last four years of an exceptionally busy and active official life in India ; his servant had orders to enter his room before daylight, to close every door and window, as otherwise the light was apt to upset him for the day.

4. An ophthalmic surgeon in large practice suffered so severely from his eyes that he had to devote Sundays to lying in a darkened room, in order to rest himself sufficiently for the work of the coming week. He was only able to carry on by the determination "to stick it" at all costs.

5. A missionary, who had landed in India full of enthusiasm, was seen in a condition bordering on insanity ; he said that life was one long misery ; even in the dark room the least ray of light annoyed him. An Ichabod had been written across his once ardent missionary zeal, and his one desire was to obtain a medical certificate that would enable him to escape from "this hateful glare."

Ætiology.—There is an idea prevalent among young men who have recently arrived in the Tropics, that it is

a good thing to "get used to the sun." Such an idea is mischievous and dangerous to a degree. During the earlier years of his residence in the East, the European feels the sun but little. As time goes on, his powers of resistance diminish, sapped by the enervating influences of a tropical climate. Little by little there forces itself upon his mind the realisation that he must look on the sunlight of the East as a danger, and that he must be careful to avoid undue exposure to the solar rays. Should he at any time have a "touch of the sun," this discovery will come home to him with redoubled force. If there is one piece of advice that should be impressed on the newcomer to the Tropics more carefully than any other, it is "avoid the sun."

The influence of glare in the Tropics is naturally at its maximum in "the hot weather," when the dry burning winds, which feel as if they blew straight from a furnace, and the widely floating dust pave the way for, and accentuate, the injury inflicted by the chemically active solar rays. In addition, the relative absence of atmospheric moisture at such times removes one source of protection, since the heat-rays are stopped in lesser numbers; for it is well known that the red emanations are stopped by water or by watery vapour. Lastly, the absence of vegetation has to be taken into account. The popular idea of the Tropics is one of luxuriant vegetation, on whose cool greenness the eye rests with soothing satisfaction. The facts are far otherwise during a large part of the year, as those whose lot it is to serve the British Raj in far distant lands know only too well. With the cessation of the rains and the advance of the hot weather, great tracts of country dry up, until hardly a leaf or a blade of grass is to be seen. The shimmering heat haze dances day after day, and month after month, on powdery, dusty plains, which are a trial to the eye, even when their prevailing tone is red or brown, but are a torture when white, as they so often are.

Then again, the occupations, which involve continuous and prolonged exposure to bright light in the East, are to be reckoned with in studying the ætiology of glare asthenopia.

The engineer who toils all day superintending the building of a bridge, the executive officer whose duty necessitates long rides across country in the daytime, the superintendent of a salt factory, exposed to the dazzling glare of the salt dumps, the ophthalmic surgeon, who adds to the stress of tropical glare the strain of constant ophthalmoscopic and retinoscopic examinations—all these and many others are to be found enrolled among the sufferers from this affection. Men and women seem equally prone to be attacked. Errors in refraction play no part in the causation of the trouble, though they may help to keep it up, once it has been started. Europeans suffer more often than natives, but the dark are affected equally with the fair. One meets with blue-eyed Anglo-Saxons, who can shoot or ride all day in the sun without suffering the least inconvenience, whilst, on the other hand, typical examples of glare trouble are not uncommon among dark-skinned and darker-eyed natives. It is therefore quite clear that the idea, that the question is one of the depth of pigmentation of the lids and of the structures of the eye, is an absolute fallacy. It is not suggested that the natural provision of pigment in the dark-skinned races is not meant as a protection against the sun, for it certainly is; this is proved by the suffering of native albinos in the Tropics. What is here implied is simply that glare asthenopia is not a manifestation of want of protection due to deficient pigmentation. It is necessary to look further than this for the true cause of the trouble, which many of the best authorities believe is to be found in the action on the conjunctiva, and possibly on the cornea as well, of the rays belonging to the violet end of the spectrum. The congestion of the retrotarsal folds of the conjunctiva, which has already been dealt with, is almost certainly a manifestation of the chemical action of the rays whose vibrations are of short wave-length. That this is so, is proved by the fact that the condition may be relieved, if not cured, by careful attention to the conjunctiva, and especially to its retrotarsal folds.

The suggestion has been made that the pain suffered by glare patients is largely mechanical in origin, and due to

the screwing up of the eyes and the wrinkling of the brows, resorted to by these people, in order to minimise the discomfort from which they suffer. According to this view, the puckering of the brow squeezes the supra-orbital nerve against the frontal bone, and so causes pain and headache, radiating throughout the area of the supply of the fifth nerve. To the author this seems a confusion of cause and effect, for he looks on the wrinkled face and half-closed eyes of the asthenope as a defence against the very pain we are discussing, and not as its cause, though it would be difficult to say that the muscular action might not aggravate the patient's sufferings. Then again, it has been said that the intense contraction of the pupil under the influence of light, mechanically presses on, and so over-excites the sensory nerves with which the iris is so richly endowed. In those cases of acute glare or electric conjunctivitis in which marked meiosis is present, the argument is probably a valid one ; but it is quite certain that in the majority of the instances of glare asthenopia met with in the East, the pupils are of normal size, and there is no excessive action of the constrictor fibres present. So far as these patients are concerned, the explanation certainly fails to satisfy. Nor is there much to be said in favour of the idea, that the sensory nerve fibres in the choroid may be painfully stimulated by the action of light, though it must be admitted that the subject is a very difficult one, owing to the scantiness of the available data.

It is sometimes assumed that the pain met with in phlyctenular ophthalmia, and in the presence of small foreign bodies on the surface of the eye, is due to reflex blepharospasm. This has been used as an argument in favour of a like view being taken of the cases of glare asthenopia. But, does not the evidence, for as much as it is worth, point all the other way ? The extreme sensitiveness of the cornea and conjunctiva, in these cases, provokes a very severe spasmodic defensive action whenever the eye is exposed to light. The troubles of the glare asthenope would appear to differ from this mainly in their intensity. The suggestion put forward is, that in both alike the

terminal filaments of the fifth nerve on the cornea and on the conjunctiva, are irritated by the action of the ultra-violet rays, and that the amount of the reflex blepharo-spasm present is decided by the state of the nerve terminals.

Treatment.—This may be divided into two sections—(1) The curative, and (2) the prophylactic. We shall consider them in turn.

Curative Treatment.—Very much can be done by attacking the conjunctival condition, but it must be remembered that unless our remedies can penetrate to, and act upon the retrotarsal folds, they will probably fail to cure. Drugs which cause pain and irritation, such as silver nitrate or zinc sulphate, are comparatively valueless for our purpose when dropped into the eye, since the protective spasm they set up effectually prevents their making their way in force back to the fornix. For this reason argyrol is a remedy of much greater value. When used in $12\frac{1}{2}$ per cent. solution, twice daily, for periods of a fortnight at a time, with intervals of a fortnight between, it will often effect considerable relief in the course of three months, and that without producing appreciable argyrosis. During the fortnight intervals, zinc drops may be used with advantage (zinc sulph. grs. iv., alum sulph. grs. ii., acid boric, grs. x., aq. dest. ad ℥i) every morning. If these produce much spasm, they should be preceded three minutes earlier by a drop of 4 per cent. cocaine. If this treatment fails, the lids should be everted and painted right back to the conjunctival reflection, twice weekly, with a 2 per cent. solution of silver nitrate.

In severe and long-standing cases, in which the patient's health is broken down, a change to a climate like Northern Europe is strongly indicated. Many patients are, for the time being, cured by a change to England. It is obviously advisable for them to avoid a snowy country at first till the eyes are restored by rest.

In less aggravated cases, much may be done without a change of locality. Should the headache be severe, rest in the horizontal posture in a darkened room for a few days is indicated. One patient with severe asthenopia improved

so much after twenty-four hours' such rest that he was able to resume his work, taking, of course, all due precautions. A dose of bromide or sulphonal will help the sufferer to obtain sleep—the best of all forms of rest.

Prophylactic Treatment.—When the eyes are less hyperæsthetic, or in milder cases from the first, the patient may be allowed to get about. He should invariably wear tinted glasses when exposed to sunlight, and should also wear a wide rimmed sun-hat.

There are a number of varieties of tinted glass on the market in the East: some of them are peacock-blue in colour, others present various shades of greenish-yellow, whilst others still are of the neutral-tint variety, sometimes spoken of as "smoked glass." It is obvious that the blue glasses are wrong in principle, and yet, strangely enough, patients will be found who experience great relief from using them. The yellow-green glasses, though sounder in principle, are extremely irritating to many eyes, and yet these, too, have their adherents. Since the advent of Crookes' glass all other forms have become out of date. This material is the product of the work of the distinguished physicist Sir William Crookes, and is made in two varieties: The "A glass" contains cerium nitrate, and by virtue of this it has the power of stopping a very large proportion of the rays belonging to the violet end of the spectrum. The "B glass" has a neutral tint imparted to it by the further addition of uranic oxide, nickel oxide, and cobalt sulphate; it can be obtained in various depths of shade. Both forms of Crookes' glass have the great advantage that they present objects in their natural colours, whilst the A glass confers a further benefit on the wearer, inasmuch as it looks like ordinary glass. It is, however, only suitable for mild cases, or for wear in glare of very moderate intensity. It is important to place on the patient the onus of choosing the depth of neutral tint most suitable for his own convenience, since he alone can tell how much assistance he requires. Spectacles to any prescription can be made from either form of Crookes' glass, and any good firm of opticians in the East will pro-

vide the surgeon with a standard empirical set of tinted glasses wherewith to test his patient. For wear in the sun, goggles with gauze sides are much preferable to those with flap sides. The objection to the former, that they are hot, is imaginary; they are both cool and restful. The gauze cups should be cut to fit the orbital margins closely below and on the outer sides, but a wide gap should be left above, under cover of the sun-hat, for ventilation. A good firm will turn out a gauze side which fits the patient's face very closely. If this is done no light is allowed to glance from below or from the side on to the eye. Velvet linings to the rim soon become sweat-soaked and hard, and are most uncomfortable to wear. They are unnecessary if the sides are well cut.

For those who are obliged to ride in the sun, and who are very sensitive to its influence, an opaque outer shield may be applied to each side. A space should be left between the shield (which should be of some light material, *e.g.* aluminium), and the gauze cup. Ventilation is thus permitted, while the wearer is protected completely from side glare. Such glare-protectors must necessarily have the disadvantage of looking ugly—a very small matter.

The outer sides of the wire gauze or metal protectors may be bright, in order to reflect the sun's rays; but the inner surfaces, next the eyes, should always be painted dull black. This greatly adds to the patient's comfort.

When driving about in the hot weather, the patient will do well to keep to a closed carriage. An arrangement of waterproof cloth screens around the brougham or motor can be made by any carriage-builder, and effectually protects the occupant from glare, while it ensures ventilation, coolness and comfort, such as cannot be got in a closed-up vehicle. Needless to say, the front and sides of the brougham are kept open, protection being entrusted to the blinds. In the house, the subject should work in a dull light, a result easily obtained in the East by a suitable adjustment of tatties.

It is well to have the doors and windows closed in the early morning by a servant, before daybreak, as the head-

ache started by glare for half an hour between sleeping and waking, or even while asleep, will sometimes produce a day's headache in a sensitive subject. All lamps, etc., should be shaded, so that while good light is thrown on the table or elsewhere, no direct rays strike the eyes.

When the surgeon has cause to believe glare asthenopia to be present, and indeed he should seldom be in doubt, as the diagnosis by exclusion and by the history is easy, there are two mistakes he should avoid, namely,

(1) making any unnecessary ophthalmoscopic examination ; and

(2) dilating the pupil with mydriatics and so increasing the amount of light that gains access to the eye.

Either of the above procedures will aggravate the morbid condition, and both are therefore unjustifiable. If, for any reason, it is thought imperative that the fundus should be examined, the quicker it is done the better, but certainly it should not be considered a routine procedure in all cases.

The details that have been given may seem to be trivial and commonplace, but if attended to, they ensure success. Their real value will soon be apparent in the gratitude of the patients. No one, who has had the misfortune to be a victim to this form of neuralgia, will be surprised that its relief should earn the deep and lasting gratitude, which it certainly does. Again be it said, that there is no such thing as getting used to the sun, and that the idea that "pampering one's eyes with dark glasses" will make them hypersensitive, is an error founded on bad physiology. On the contrary, one will find that a patient who at first is never happy out of doors in sunlight, will, after steady use of precautions, so greatly improve that he will be able to bear a light, that, before, he would not have ventured into. If he is wise, he will not let his recovery lead him to rashness, but will still use every possible precaution. If he does not, he will run a grave risk of recurrence of his symptoms.

Shortly before the Great War, Ruhemann, of Wilmersdorff, near Berlin, prepared a soluble monoxide of æsculin

(from the horse-chestnut), which he neutralised with boric acid. This was commercially known as "Aqua Zeozoni," and was prepared in 0·3 per cent. to 0·5 per cent. solutions. Æsculin absorbs solar rays of wave-lengths between 300 and 400 microns. It is stated that the commercial solution causes no irritation, and produces no staining, even when instilled thrice daily for long periods, whilst it is of great value to sufferers from photophobia. Alt and the author both tried the preparation in glare cases, and were favourably impressed, but the material was hard to obtain under the most auspicious conditions, and disappeared with the advent of the war. It seems worthy of a further trial in the future.[1]

[1] For References, see end of Chapter III.

CHAPTER III

GLARE CONJUNCTIVITIS

Glare conjunctivitis is very closely associated with the condition we have just been discussing. It differs from it mainly in being much more rapid in its onset, more marked and definite in the physical signs it presents, more acute in its course, and more transitory in its effects. All grades of the condition may, however, be met with, and an attack which begins as a conjunctivitis may pass into one of long-continued asthenopia. It also has strong affinities with a wide group of better known affections, which include snow-blindness and the various forms of electric ophthalmia. The last-named may be due to a sudden flash of lightning, to the shortcircuiting of an electric arc, or to prolonged exposure of the eyes in an X-ray room or in a Finsen light institute; and yet, clinically, the picture may be alike in all. There can be little doubt that the causative agent in all forms of glare conjunctivitis is the action of the ultra-violet rays of light on the superficial structures of the eye. Distinct signs of conjunctivitis are present. These may be slight, or may be so marked as to give rise to a condition of chemosis and œdema of the lids, or again may occupy any intermediate position in intensity. The protective epithelium of the cornea may be found to be absent, giving rise to superficial erosions, which add enormously to the acuteness of the patient's sufferings. Extreme photophobia, spasmodic meiosis, profuse lachrymation, and painful lid spasm may each and all be present. The first signs of glare conjunctivitis are delayed in their appearance, until some hours after the exposure which gives rise to them. This is a feature which this affection has in common with the other allied conditions we have been discussing, and

also with some of the forms of conjunctivitis with which we have become familiar during the war, as an outcome of gas-poisoning.

Any strong form of glare may provoke an attack of conjunctivitis, whether it comes off the sea, off a sandy desert, off white roads, off dazzling salt pans or salt heaps, or off snow. Many of the cases are due to an association of wind, dust, and glare, and the former influences must be carefully borne in mind in all our measures for the prophylaxis of the affection; for it is obvious that the desiccation of the corneal and conjunctival epithelium caused by wind-dryage, and the trauma inflicted on this protective coat by dust, must facilitate and intensify the unfavourable chemical action of the ultra-violet light.

The glare troubles met with among the sponge fishers demand a passing notice. The fisherman spends long hours on the sunlit ocean, lying face downwards on a bed of dried sponges laid along the gunwale of his boat; his head hangs over the side and is plunged in a barrel, which is lashed to his craft. A sheet of glass is substituted for the bottom of the barrel, and this is kept submerged below the level of the water, in order to eliminate the disturbing influences of the wind and waves on the surface. In this way a clear view of the ocean bottom is obtained, and by means of a long pole the sponges are detached from their bed and fished up. It has been suggested that the cramped position of these fishermen, with their heads always hanging down, is responsible for the symptoms of which they complain. These are said to include asthenopia, hazy vision, and the presence of muscæ volitantes; the visual activity, the visual fields, and the power of colour perception are unaffected. Possibly the condition is more nearly related to glare asthenopia than to glare conjunctivitis, but against this view it must be recorded that the attacks are short-lived and easily cured. The clinical details given are rather scanty, and the subject would appear to be worthy of further study, especially as it seems not unlikely that the syndrome may be due to the scintillating effects of light in tropical waters. In connection with this point, Treacher

Collins draws attention to the fact that the men suffer less when the sky is cloudy, and that they recover rapidly with rest and the use of dark glasses.

The Treatment of Glare Conjunctivitis. — This is common-sense and symptomatic. At an early stage, cocaine is a godsend, especially if combined with a local application of cold compresses; atropin may be of great service; argyrol drops (12½ per cent.) should be freely instilled at frequent intervals. The patient should be protected from glare either by darkening the room or, better still, by providing him with glare goggles. He should be warned of the danger of contracting long-continued glare asthenopia, and advised to guard himself against the kind of exposure which led to the attack.

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CHAPTER IV

INJURIES OF THE EYES BY LIGHTNING

At certain seasons of the year, violent thunderstorms occur with considerable frequency in tropical countries, and lightning stroke is therefore relatively common. The list of the ocular structures which may be damaged, and of the lesions inflicted, is a long one, and includes—(1) Inflammatory conditions of the conjunctiva, the cornea, the sclera, the uveal tract, and the optic nerve; (2) alterations in the transparent media (aqueous fluid, lens, and vitreous); (3) evidence of traumatic violence to any or all of the structures of the globe: and (4) nerve lesions, inclusive of optic atrophy, and paralysis of the extra-ocular muscles, and of the neighbouring nerves.

In order to arrive at an intelligent understanding of the numerous lesions which are on record, it is first necessary to consider the various ways in which a violent discharge of atmospheric electricity may possibly, and conceivably, affect the eye: and here it may be pointed out that there would appear to be no essential difference between the consequences of lightning stroke and those of heavy charges of high potential industrial electricity.

The Methods by which Damage can be inflicted on the Eye by Lightning

A. When the Current does not actually pass through the Body—(i.) **The action of actinic light rays.**—A bright flash of lightning, or of any other form of electric discharge, is very rich in ultra-violet rays: consequently, it may profoundly affect the conjunctiva, cornea, and lids, pro-

ducing a severe form of electric retinitis, accompanied by meiosis and photophobia ; this condition, as has already been pointed out, is closely allied to glare conjunctivitis. (ii.) **The action of luminous rays of light.**—Such a flash, by reason of its excessive brightness, may affect the retina and choroid, just as intense solar light has been shown to do. Whilst it is known that the great majority of the ultra-violet rays are cut off by the various media of the eye (the cornea, lens, and vitreous), it is by no means certain that, under such exceptional circumstances as those of a lightning flash, the delicate retinal coat is fully protected by the physical mechanism, though the latter fully suffices for ordinary conditions of lighting. In any case, the severe dazzling occasioned by the discharge of a large volume of high voltage electricity, proves that we have to do with a phenomenon in which the action of the luminous rays of the spectrum is very intense. This factor alone would serve to explain the central scotomata, both transitory and permanent, from which many of the patients suffer. It possibly also accounts for the cases of congestion, inflammation, and atrophy of the optic nerve.

B. When the Patient is actually struck by the Lightning; in other words, when the electric current passes through his tissues. (iii.) The passage of a powerful current through the moist tissues of the body is believed to be accompanied by the setting up of a transitory, but not unimportant, **electrolytic action.** It is claimed that the cataract and the optic atrophy, which are sometimes revealed weeks or even months after the accident, are consequences of this electro-chemical action, which is stated not to be due to the action of heat-rays, but to the power that electric discharges possess of killing cells even without the development of heat. In the case of the lens, Hess has shown that, as a result of electric shocks, the epithelium of the capsule is caused to die, with the result that a clouding of the fibres in the neighbourhood takes place. Apart altogether from this electrolytic action, there is another factor which must not be lost sight of, namely, (iv.) **the actinic influence in transit**

of the ultra-violet rays in which lightning is so rich, for it seems a fair presumption that, if the ultra-violet rays have a powerful influence on the tissue cells when acting on them from a distance, we cannot afford to neglect the probability of the same, if not of a still more powerful influence, when the lightning flash actually traverses the tissues. (v.) It is sometimes asserted that **the heat-rays** are of comparative little importance in producing the eye lesions of lightning stroke. This idea would seem to have arisen from the known fact, that, when light falls upon the eye, its heat-rays are largely, if not wholly, absorbed by the fluid media of the globe. In lightning injuries, however, the conditions are entirely different. We know that any structure through which lightning passes is likely to be charred thereby; and if the stroke is a very severe one, the parts may be extensively burnt; but, even in a weak stroke, there must be considerable overheating of the parts; in other words, we have here to do with a burn of low degree, the after-consequences of which may be serious out of all proportion to those which appear at the moment. How are we to explain the widespread inflammation so commonly met with after lightning stroke? Is it due to electrolytic action, to actinism, to heat-rays, to mechanical trauma, or to all combined? Who shall apportion the share to each? (vi.) Lastly, we come to speak of trauma—that is, of **the results of mechanical violence;** and in doing so, we must take account of two forms which these may take: (*a*) The individual cells of the tissue may be either killed outright, or so damaged that they either die, or, at least, fail thereafter to function normally; or (*b*) the mass of the tissue itself may be torn, overstretched, or in some other way damaged to such an extent, as to interfere partially or entirely with the physiological activities of the organ of which the tissue forms a part. Among such cases we may class the ruptures of the choroid, the concussion injuries of the lens, which end in early complete cataract, some of the muscular paralyses met with after lightning stroke, and various other lesions.

The Lesions inflicted on the various Structures of the Eye

It will be clear from the foregoing summary that, in a large number of cases, it is impossible to refer each lesion to its exact cause. The forces at work are too complex, our data are too scanty, and our knowledge is not sufficiently exact; but, we are now in a position to pass on to a systematic review of the lesions sustained by the various structures of the eye, taking the latter in turn.

The Conjunctiva and Lids.—A few hours after exposure to a lightning flash, the patient may complain of a feeling of sand in the conjunctival sac, and of pain in the eyes and forehead, associated with photophobia and corneal trouble. The lids are red and swollen; there is marked conjunctivitis, and considerable blepharospasm may be present. In some cases there is distinct ecchymosis both of the lids and of the conjunctiva. In one case a larger subconjunctival hæmorrhage is on record (Jellinck). It is probable, as has already been pointed out, that these are all consequences of the strong action of the actinic rays in which lightning abounds.

The Cornea.—In a number of cases the cornea shares in the conjunctival trouble, and it seems certain that in many of them the causation of the steaminess, cloudy vision, and photophobia, which are found to be present, is the same as that described in the previous paragraph. There are, however, a number of cases in which the cloudiness of the cornea would appear to be due to a deep-seated keratitis, associated with circumcorneal congestion and with the other evidences of irido-cyclitis presented by the case. It would be difficult, if not impossible, to decide which of the forms of the power of lightning should be blamed for such phenomena. It is interesting to record here that in one case (Ayres) a haziness of the cornea was associated with deep scleral injection.

The Iris and Ciliary Body.—Iritis and irido-cyclitis appear with comparative frequency in the records of persons struck by lightning, and in some of them, there

is a note of the presence of blood in the anterior chamber, and even in the vitreous. All but one of them would seem to be instances in which the patient was actually struck by lightning, and the inference would appear to be, that severe direct injury of one kind or another was inflicted in each case on the iris and ciliary body, by the passage of the electric current through the eye. There is, however, one instance of this condition from a brilliant electric discharge which did not actually strike the patient: the exception was a policeman who was exposed to a flash of lightning (Le Roux et Renaud). The deduction would appear to be that injury to these structures is due, in the great majority of cases, to direct trauma, actinism, or electrolysis. Such a view is in keeping with what we know of the power of the cornea to stop the passage of ultra-violet rays; all the same, we may expect the protective mechanism to break down when a very heavy strain is placed upon it, as in the case above quoted.

The Lens.—Cataract is one of the commonest sequelæ of lightning stroke. It may be total or partial; it may progress and become complete, or may remain stationary, or finally, in rare instances, may disappear spontaneously. One, or often both eyes may be affected. There can be no doubt that the various opacities of the lens met with are due to very different causes. We will consider this matter in some detail. The *complete cataracts* are not infrequently soft; they do not begin to appear at once; a varying period elapses; this may be one of weeks or longer. Again, the rate of the development of the cataract from its first appearance on to maturity varies greatly in different cases. It has been pointed out that, in this class of case, there is usually a well-marked irido-cyclitis shortly following the injury, and, further, that in animals which develop cataract as a result of electric shocks, the same sequence of events is observed (Dor), namely, at an early stage severe ciliary congestion with hæmorrhages, and later on, in from eight weeks to three years, the development of cataract. The question which suggests itself is: Have we here to do with cause and effect, or must we ascribe the initial irido-

cyclitis and the late development of lens opacities to the violence of the injury inflicted at the time? Possibly both factors may be in operation. It is well known that a complete cataract may follow indirect trauma, or the performance of a Foerster's operation for maturation, and the accepted explanation is, that in either case tiny ruptures of the lens capsule occur, which admit the gradual seepage of aqueous fluid into the substance of the lens. It would not be surprising if a similar action were brought about under the influence of the violent concussion to which the eye is subjected in lightning stroke. It must also be borne in mind that the presence of a severe irido-cyclitis, apart altogether from secondarily influencing the condition of the lens, may hide the early stages of the development of a cataract, and may thus lead to the appearance of the opacities escaping notice for some considerable time.

Partial opacities may be dotted, linear, or net-like. It has already been mentioned that the epithelium of the lens capsule may be destroyed or severely damaged by electric shocks, and that a clouding of the lens in the neighbourhood results therefrom. Obviously, if the lesion is a local one, its results, too, may be correspondingly confined in their area of manifestation.

Posterior cortical cataract has been described by various observers, and is presumably due to defective nutrition, owing to the injury inflicted on the ciliary body at the time of the lightning stroke.

An endeavour has been made in the above paragraphs to classify the ætiology of the cataracts which follow lightning stroke, but it is obvious that, in any individual case, we can do little more than guess. The violent effects of concussion and of disruptive trauma, the action of actinism and electrolysis, and the coagulating influence of heat, must one and all be taken into account at the moment of injury, whilst later, the secondary factors we have already indicated come into play.

The Vitreous.—Opacities in the vitreous have not infrequently been noticed, and sometimes in such numbers as seriously to interefere with vision. Some of them are

doubtless due to cyclitis, choriditis, or retinitis; others, to the remains of hæmorrhages, poured out at the time of the injury into the hyaloid cavity; whilst still others may possibly be the results of severe disruptive trauma.

The Choroid and Retina.—A central choroido-retinitis has been observed, not only following the flash of a violent electric discharge (Knapp), but also when the patient has actually been struck by lightning (von Marenholtz). It is probable that, in both cases, the cause is the same, namely, the focussing on the macular area of a brilliant flash of light. In fact, we have here the same condition as that which we have described under eclipse blindness. The only difference is that the source of light is not identical in both cases; in the one it is the sun, in the other a brilliant electric discharge.

Rupture of the choroid has also been noted in these cases, and must presumably be ascribed to the severe trauma inflicted, in other words, to violent disruptive force. To the same agency we must ascribe the instances of retinal hæmorrhages recorded by Yarr and others, and the case of bi-lateral retinal detachment, which we owe to the former.

The Optic Nerve.—Very profound changes have been observed in the optic nerve. At an early stage there may be hyperæmia or actual neuritis; whilst, if the case is seen later, the appearances are those of optic atrophy, which may affect only a part of the disc (Collins, Valois). As an early symptom, erythropsia has been noticed (Le Roux et Renaud). Later, the fields have been observed to be contracted, in association with impairment of central colour vision (Collins, von Marenholtz).

Glaucoma.—In Hilbert's case, a lightning stroke was followed by an acute attack of glaucoma, from which the patient recovered in three weeks' time. It would seem to have been secondary to congestion of the uveal tract. Possibly, transient rises of tension would be more often noticed in similar cases, if the surgeon were always on the look-out for them.

Pareses of External Ocular Muscles.—These have been

recorded by various observers, and are obviously traumatic in origin. As might have been anticipated, the levator palpebræ is included in the list. Obviously the injury may either affect the muscles or their nerves. Diplopia may be a source of complaint.

Paralysis of Accommodation and Mydriasis. — Instances of both these have been met with, and are presumably to be explained by injury either to the muscular or to the nervous structures concerned, or possibly to both. Spasmodic meiosis, on the contrary, is probably due to the corneal condition already dealt with in a previous paragraph.

Injuries to other Nerves may be associated with the eye lesions we have been discussing. In Collins' case, the seventh and eighth nerves were both affected.

When wounds are found in the neighbourhood of the eye, after a patient has been struck by lightning, it is important to remember that they may be due, not to the passage of the electric current, but to fragments of wood, stone, brick, metal, etc., twisted off and flung about by the electric discharge in its disruptive passage through neighbouring structures.

A review of the literature makes it quite clear that working, during a thunder-storm, with telephonic or telegraphic instruments involves a very distinct increment of risk. A number of those, whose eyes have been damaged by lightning, have been telegraph operators or persons using the telephone. This is probably to be explained by the fact that in both cases the receivers are placed against the ears, and consequently the shock is likely to be delivered through the head.

There is a further point of interest in countries where severe atmospheric electrical disturbances take place, namely, that, as Weir Mitchell has pointed out, certain patients suffer from migraine and allied affections when the atmosphere is charged with electricity, and quite independently of eye strain. The author has met with cases of the kind. Such patients will know of the coming of a storm in advance.

Prognosis and Treatment

Very much depends on the parts damaged and on the extent of the lesions. Electric ophthalmia will usually pass away of itself, though the recovery in some cases may be slow. Opacities of the cornea may, however, remain permanently. Where deep-seated injury has been inflicted, the inflammatory conditions set up may run an extremely protracted course, and a greater or less measure of permanent blindness may result. Rarely partial cataracts have been found to undergo spontaneous resolution. The rate of progress of the total cataracts varies greatly, but completeness may be attained in a few months. If the retina and optic nerve are undamaged, the prognosis of operation for this form of cataract appears to be quite favourable. The treatment of the various conditions which have been enumerated must be conducted on rational lines, and the activity thereof must be in proportion to the signs and symptoms present. Rest of the eyes from light by shades and glare glasses, together with the measures calculated to quiet the general circulation, are obvious indications. Cocaine and atropin are valuable drugs ; leeches and blisters are often of service ; the relief of pain in the earlier stages will call for the surgeon's best efforts, and win him his patient's gratitude.

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CHAPTER V

ECLIPSE BLINDNESS

WHENEVER a solar eclipse takes place, a large number of patients present themselves for treatment, suffering from partial or complete loss of central vision, as a result of "having had a look at the eclipse." One can form some estimate of the danger incurred, by the fact that after the eclipse of April 1912, 3500 cases of this form of blindness were met with in Germany alone, whilst in other countries also very large numbers were known to have been affected. In tropical lands the evil is still greater, owing to two factors—(1) the greater power of the direct solar rays, and (2) the ignorance of the natives. Even in Europe a large number of the sufferers bring the trouble on themselves by looking at the sun without any form of protection to the eyes; thus Boehm found that 66 per cent. of the patients whose cases he reviewed, had watched the eclipse with the naked eye; 14 per cent. had used some form of protective glass; whilst the rest had employed shields, telescopes, opera glasses, or paper protectors. In many of the recorded cases the exposure would appear to have been fairly prolonged, often lasting five to fifteen minutes. In the East the want of precautionary measures is still more marked; many of the natives think little of watching the phenomenon steadily with their naked eyes; others use insufficiently darkened smoked glass, or some equally inefficient means of protection; still others watch the reflection of the sun in a pail of water or in a pool—a very dangerous practice.

Even apart from an eclipse, the same form of eye lesion may be met with under a variety of different circumstances. Villard speaks of it in connection with the study of sun

spots, and the observation of a transit of Venus. Kirkpatrick has studied an Eastern practice which is certainly deserving of mention in this connection, namely, "the religious rite of looking through the half-closed fingers directly at the sun; apparently a very orthodox person will do this for minutes at a time at midday." Casali has known eclipse blindness produced by reflection of the sun from water, a probably not infrequent occurrence in the

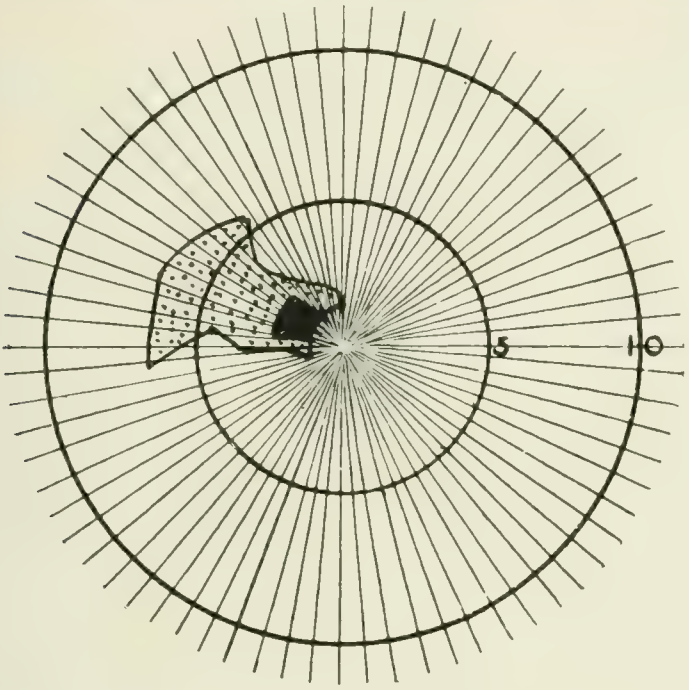

FIG. 6.—L.E. Scotoma from Sun-blinding due to exposure to the sunlight reflected from rice fields under water. Note (1) that the Scotoma is paracentral, and (2) that a large part of it is relative (the dotted area).

East. The author has recently seen, in consultation, a European, who on one occasion had to ride for several hours in the early morning alongside of "paddy-fields," lying under water with the sun strongly reflected from them on to his left eye (Fig. 6). He presented a typical picture of solar retinitis, indistinguishable from that met with in eclipse patients. In Bruder's case, the patient is stated to have been exposed to the sun, but he did *not* watch the eclipse. Even now we have not exhausted the category of recorded causes, which include the glare off a calm sea

when a small boat is being steered in the sun's eye, and the brilliant light reflected into a sextant when a sailor is taking an observation in the Tropics, without the necessary precaution of darkening the eye-piece of the instrument.

Both sexes and all ages suffer, but Boehm believes children to be relatively immune, and quotes the case of a teacher and his pupils who observed the 1912 eclipse together, with the result that the former alone suffered, the children all escaping. The same authority believes eclipse blindness to be rare in myopic eyes. It is possible that the dark pigmentation of the residents of tropical countries affords them no little protection against the dangers of solar retinitis.

Whether one or both eyes are affected depends, in any individual case, upon whether the patient has closed an eye or not whilst looking at the eclipse. It would appear that the majority of people watch an eclipse with only one eye open.

The History of Eclipse Blindness.—We are indebted to Beauvois and Werdenburg, and especially to the former, for our information on this subject. It would appear from the writings of Aristotle, Galen, Lucretius, and Xenophon, that the Greeks and Romans were acquainted with the occurrence of blindness from exposure of the eyes to the rays of the sun, or to reflection from snow. Little is recorded after that period until the seventeenth and eighteenth centuries, when it is evident from the writings of Gillemeau, Hoffman, Saint-Yves, De Bouffon, and others, that the condition was well known. Since then it has frequently been described under the synonyms of retinal dazzling, scotoma helielecipticum, retinal solar erythema, solar retinitis, etc. No period of solar disturbance has, however, been so rich in the literature it has produced as the year 1912, the records of which have been freely drawn upon by the author.

Signs and Symptoms.—These vary greatly according to the severity and duration of the exposure of the eye to the source of light, but other influences probably play a not unimportant part. Amongst these are to be counted the protection afforded to the eyes by natural pigmentation

and personal idiosyncrasy. By far the most important symptom is the presence of a *positive central scotoma*. Directly after the exposure, the patient notices a persistent and troublesome after-image, which obscures his central vision, moves with every movement of the eye, and never shifts its relative position to the remainder of the field. The size varies from 0·50° to 3° in diameter. Villard describes it as blotting out a face at 20 m. distance. The same author states that the edges of the scotoma are clean-cut, and this is in accordance with general experience; but Birch-Hirschfeld finds that it is surrounded by a relative scotoma for yellow, which may vary considerably in width. In mild cases the defect may be relative throughout, but such would appear to be very rare; Werdenberg, who gave careful attention to this point, found only two relative scotomata in 115 cases. A stenopaic slit or hole is said to be helpful in the detection of faint relative central scotomata (Tyson). Whilst all writers are agreed that central scotomata are far more commonly met with than paracentral, there are considerable differences in the statistics presented on this head; thus Werdenberg found only 6 instances of the latter in 134 cases, whilst Birch-Hirschfeld found 19 in 50 cases. Ask's work, which would appear to have been very carefully carried out, since he studied the defects by Bjerrum's method and by the aid of special diagrams, would seem to indicate that the scotoma is much more often paracentral than is usually thought. He explains this position of the scotoma by the patient's tendency to fix a little eccentrically for the strong light of the sun. The form of the defect varies greatly. Werdenberg found that in most cases it was round, though in a few it was ring-shaped, oval, stellate or crescentic. Some of Ask's careful diagrams are shown in Fig. 7, whilst a case of the author's has been illustrated in Fig. 6. It is probably not unjust to hazard the suggestion that the usually accepted opinion, that the scotoma is circular, is dependent largely on defective perimetric methods, and on the view that it is an optogram of the sun. But, in the latter case, we should not expect the heliogram to be circular; we should rather anticipate, as Werdenberg

did, that its form would be determined by the area of sun exposed. This idea is, to some extent, borne out by Ask's diagrams. A curious feature of the sun scotoma is that an oscillatory or rotatory movement is sometimes observed at its periphery (Beauvois, Collins, Cords, Villard). When an eclipse scotoma begins to disappear, which in favourable cases it often does, it may do so either by diminishing in size, or by fading throughout its whole area.

Another sign which does not appear to be very infrequent, and which might probably be more often found if looked for carefully at an early stage, is the presence of a *ring scotoma*. Jess found it in 36 out of 51 eyes he examined; it was generally only relative for both white and colours, but in a few it was absolute for colours.

FIG. 7.—Various forms of Eclipse Scotoma, as depicted by Ask. Each circle represents a degree of the visual field. (*Ophth. Year Book*, 1913.)

It lay between the 20° and 50° circles, and varied from 10° to 25° in width. The ring was usually incomplete, and sometimes was only one-eighth of the circle. Speleers was able to demonstrate ring scotoma in 6 out of 13 cases; in 11 of the cases there was also an enlargement of the blind spot. Ask observed a relative ring scotoma in two patients within ten days of the injury, without any visible change in the retina; and Claiborne found a persistent ring scotoma in a man who had to watch a furnace through a round door; but in this case the optic disc was very red, and there was venous congestion. Franke observed the disappearance of a ring scotoma by its breaking up into several separate areas, as a first step.

What would appear to be a closely allied phenomenon has been observed by Zade in aviators and in those who were engaged in serving anti-aircraft guns. He found

that 5 out of 9 aviating officers had ring scotomata, and that a large percentage of anti-aircraft gunners had the same defect. The scotoma, in most cases, extended from 35° to 50° from the fixation point, and was only a few degrees wide. He suggested that the glare, these men were subjected to, was likely to affect the peripheral zone of the retina before any other part, this area being physiologically weaker, as is shown in pigmentary degeneration. In 150 cases of dazzling in the regular army, Zade found no scotomata, whilst in 160 cases in the aircraft service, 31 showed scotomata : these were found mostly in the crews of the anti-aircraft guns ; the scotomata were peripheral and in the lower fields. In view of the extension of flying to tropical countries, these remarks merit the careful attention of all who practise there, and especially of ophthalmic surgeons.

A number of other phenomena have been observed. The *visual acuity* is always diminished, and often permanently so. There are differences of opinion as to disturbances of the *colour vision*, though apparently it is the exception for this to be affected except at the centre of vision ; nor are the *visual fields* found to be contracted. Many patients complain of *spots before the eyes*. These may be yellow, blue, bluish-grey, brown, or black ; vitreous floaters have been observed in some cases. One patient was troubled by *seeing a red ball* in front of him after viewing an eclipse (Tyson) ; others suffered from *erythropsia*.

Collins records the case of a woman who looked at a solar eclipse for ten minutes without any protection for her eyes ; for three days afterwards *everything looked violet* ; people's faces appeared bruised ; later on, when she looked at objects, they appeared distinct for a short time and then faded away ; parallel lines seemed to her wider apart at the centre of vision than farther out. Ultimately she recovered good vision, but continued to be troubled by the presence of an oscillating scotoma.

Metamorphopsia is not infrequent, and *micropsia* has also been noted. Casali speaks of *nyctalopia* as a symptom ; and Villard records a case in which there were recurrent

attacks of *hemianopsia*. Some writers mention photophobia, lacrymation, periorbital pains, and acute catarrhal ophthalmia; these are obviously due to a coincident affection of the cornea and conjunctiva as a result of glare, and should not be confused with the symptoms due to the retinal lesion.

Ophthalmoscopic Appearances. — These have been somewhat differently described by different writers, but in the main there is an agreement as to the principal features. In the very early stages there may be nothing discoverable, but later on signs are often found. Boehm found retinal changes absent in 30 per cent. of his cases; in the remainder there was clouding of the macular region, which showed yellow, white, grey or brown specks on its surface; the area generally was dark brown or grey in colour, and the fovea was reddened. Werdenberg found that out of 188 cases, 55 presented slight, and 49 marked retinal changes. According to Ferentinos, the first change is a grey spotted condition of the macula, which is surrounded by a dull red ring, and this again by cloudy retina; three to four weeks later, slight hyperæmia of the macula is observed with a bright red ring round the hyperæmic area, and a faint red ring outside this again; later, the fundus may appear quite normal. Beauvois speaks of the macula as being often reddish or greyish in appearance, and as lacking the retinal reflex; pigmented oval spots and bright and yellow dots may also be present; he, Cords, and others speak of a grey central spot in the middle of a highly-coloured macula as an "optogram of the sun." In Birch-Hirschfeld's cases, the maculas were darker than normal, and presented grey or yellowish specks of lighter colour; there was an increase in the foveal reflex. Cords, too, found the maculas darker than usual, or surrounded by a dark red ring. Uhthoff saw a normal fundus in 9 cases; in 12 there were brighter spots at the fovea, surrounded by a dark brownish red zone; in 3 there were whitish foveal spots with a dark background. Vinsonneau and others also report white spots on the macula surrounded by a zone of red. Casali speaks of the macular

region as having a wider and darker area of coloration than normal, associated with congestion of the optic disc, œdema of the retina, and venous engorgement. A definite hole in the macula is on record. Quite a number of writers record hæmorrhages in the macular area ; amongst these are—Bruder (fine striated hæmorrhage), Franke (a wedge-shaped hæmorrhage), Pergens, Stook, Terlinck, Villard, and Wibo. Congestive or inflammatory changes in the optic nerve, and subsequent atrophy, have been observed by Birch-Hirschfeld, Casali, Cords, Cosmettatos, Valois and Lemoine, and Wibo. In a case seen by the author some months after the injury, whilst the whole of the optic nerve head was paler than normal, the papillo-macular bundle was clearly much more atrophic than the rest of the papilla.

Kirkpatrick's observations on the opthalmoscopic appearance, after sun-injury, will be found recorded in the contribution from his pen in Section IX. of this work.

It is of interest to observe that in the experience of able surgeons, the visual disturbance occasioned has not always been proportional to the extent of the ophthalmoscopic changes which were recognised as present.

Pathology. — Our knowledge of the anatomical changes in eclipse blindness is wholly based on animal experimentation, but a certain amount of progress has been made by a study of the physical conditions present. It is the purpose of the arrangement of the refractive media of the eye to focus the image of the object looked at upon the macular area of the retina ; it had, therefore, been too lightly assumed that when a man looks at the sun, the solar rays thus focussed upon his retina, burn the delicate elements of that structure, just as a bi-convex lens sets light to structures on which the sun is focussed through it. It has, however, been pointed out that the aqueous fluid interposes a powerful barrier to the passage of the heat-rays. Again, it has been suggested that the actinic, ultra-violet rays, which are known to have a deleterious influence on so many of the structures of the body, may be responsible for the retinitis observed. Once again, it is countered that these rays are not permitted to reach the retina in any quantity, since

they are stopped by the cornea, lens, and vitreous. Two alternatives would appear to remain: Either we must lay the lesion to the door of the luminous rays, or we must assume that such scanty amounts of the calorific or actinic rays as make their way through, are sufficient to produce the serious phenomena of solar retinitis. In favour of the former supposition may be mentioned the fact, that the luminous rays are known to excite movement in the retinal cones and pigment of the eyes of certain of the lower animals; it is readily conceivable that any great increase in the activity of such a process might lead to pathological changes in the delicate structures concerned. It will be well, however, to bear in mind Birch-Hirschfeld's warning, that it is hardly safe to leave the heat-rays entirely out of our calculations. A mechanism, which suffices for all ordinary conditions, may conceivably break down under the stress of such a concentration of solar rays as we have to do with in cases of eclipse blindness. Indications are not wanting that such a view is again gaining ground; indeed, it has recently been put forward by Verhoeff and Bell. It remains to be mentioned that Wydler, who approached the subject from a different angle, namely, that of an experimental study of after-images, came to the conclusion that it was the visible rays of the spectrum which are at fault in these serious solar cases of eye injury. We must await the advent of fuller knowledge with an open mind.

To Birch-Hirschfeld we are indebted for our knowledge of the anatomic conditions present, which is based on his experiments on rabbits. The essential element is an injury to the outer layers of the retina, inclusive of the pigment epithelium, and to the choroid. The rods and cones are swollen and distorted; there is hyperchromatosis, coagulation of albumen, and transudation of fluid; the choroid is hyperæmic. In this connection, it is of interest to recall the experiments made on animals by Widmarck with powerful electric light. The changes produced consisted in a localised retinal œdema, with more or less destruction of the nervous elements of the retina, namely, the outer layers,

inclusive of the rods and cones, and the inner layer of nerve fibres.

Prognosis. — This depends largely on the amount of injury that has been inflicted. If it has been slight, a complete recovery may be anticipated; at least such is the accepted opinion, based on the experience of a number of observers. It must, however, be remembered that it is very difficult to be sure that recovery is really complete; the author has under his care a young man who watched the eclipse of 1901 in the East, and who might now easily be passed as "completely recovered"; but his visual acuity is a little below $\frac{6}{5}$ in each eye, and on inquiry he states that there has been a perceptible diminution in his power of sight ever since his exposure to the sun—a fact that might easily have been missed in a less able and intelligent patient with such sight as this; on careful ophthalmoscopic examination, fine light-coloured dots are found irregularly scattered over his macular area. The writer is convinced that many of the reports of complete recoveries from this and other forms of sun-trouble, would require drastic revision, if a full examination were made as a routine matter. Herein probably lies the explanation of the discordance between the views of different writers on this subject. There are certain points, however, on which agreement is fairly general, and which we may accept with very little hesitation—(1) The most favourable cases are those in which no fundus lesions can be discovered; (2) the prognosis is worse when the scotoma is absolute than when it is relative; (3) it is also increasingly unfavourable in proportion to the size of the scotoma present; (4) the longer the exposure has been, the worse the prospects; (5) the longer the time that elapses before marked improvement begins, the worse is the prognosis; if the patient is no better after a month, the outlook is not a good one, but complete recovery may be met with, even when no improvement is found until several months after the injury: on the other hand, in the slighter cases recovery may be complete within a month; (6) a complaint of marked dazzling is of bad omen; (7) metamorphopsia is a very unfavourable sign: (8) oscil-

lating scotoma would appear to be the same; it may last for months (Collins), or for as much as 45 years (Cords); (9) even in the very severe cases, great improvement may take place after a time; but, on the other hand, the condition may remain stationary, or a change for the worse may be observed.

It is obvious from a review of the literature that the surgeon, while encouraging his patient as far as possible, will be wise to give a guarded prognosis, especially in those cases in which unfavourable signs are present.

Werdenberg has supplied some very interesting statistics of the vision of 134 cases of eclipse blindness. Of these patients, 24 had V = $\frac{3}{4}$ or better: 43 had V = $\frac{2}{3}$ to $\frac{1}{2}$; and 67 had V = $\frac{1}{3}$ to $\frac{1}{20}$.

Prophylaxis and Treatment. — Once the retina and choroid have been injured by the focussing on their surface of the solar rays, it may be questioned whether any treatment we can apply is of much value. We proceed to act on general principles: The patient is kept at rest, the eyes are protected from bright light by means of dark glasses or a shade, and all reading and near work is forbidden. If the case is of recent origin, we may even confine the patient to a darkened room; and, in addition, we may employ leeches (followed by fomentations), administer a purge, and give hot foot-baths. Later, blisters may be tried, combined with the administration of strychnine and potassium iodide. Sub-conjunctival injections of normal saline solution have also been recommended; and galvanism has had its advocates.

The question of prevention is a much more important one. The practitioner in tropical lands should make it his business to issue warnings in advance of an eclipse. This was the author's practice in India. In the more civilised parts, such as the big towns with a Press of their own, this is an easy matter, for the editors will be only too glad to work hand in hand with the ophthalmologist in such a cause, publishing the facts he supplies in the form of a leader or otherwise, and giving due prominence to it. In less civilised countries or away from the big towns, the

tom-tom man, or whoever may be the local substitute for a town-crier, will make the news known far and wide. Such publicity has a double advantage; for, not only will many cases of solar blindness be avoided, but, what is more, those who do suffer will know what has happened to them, and will present themselves for examination and for treatment; the latter can at least do no harm, and may possibly do good; in any case an opportunity for studying this class of case is thus afforded the surgeon.

European experience has supplied clear evidence of the value of warning the public of the dangers to the eye associated with an eclipse of the sun. Thus, Menacho found that the eclipse of 1905 was not followed, in Spain at least, by so many distressing accidents as was that in 1900, and he attributes this happy result, in part at least, to the Press, which had striven to make the danger of unguarded observation known in advance. Lundsgaard has commented on the fact that there were 143 cases of sun-blindness in Denmark after the 1912 eclipse, whereas only 2 were met with in 1914; the public had been warned by the newspapers of the dangers of gazing at the sun with unprotected eyes, and had been recommended to protect themselves by watching the phenomenon through over-exposed photographic plates. Ask recorded similar happy results in Sweden, only one case being seen after the 1914 eclipse as against many in the preceding one. The German surgeons, too, have been alive to the value of methods of publicity of the same nature.

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CHAPTER VI

NIGHT-BLINDNESS

SYNONYM.—*Nyctalopia* (*nux* = night, *alaos* = blind, *ops* = eye)

NIGHT-BLINDNESS is very common in tropical countries, because of the frequent occurrence of the so-called idiopathic form, and of certain other factors of which we must take early account. It will save confusion to deal with the latter first.

The usual pathologic conditions which give rise to nyctalopia are just as common in the Tropics as at home, but certain additional features have to be taken into account. (*a*) The use of arsenic and quinine, and possibly of antimony, in the treatment of a variety of tropical diseases, gives rise to a number of cases of optic atrophy. One of the most troublesome symptoms of the lesser partial affections of this nature, is the difficulty patients experience in the dusk or dark. (*b*) In many backward countries the streets are not illuminated at night, and a person with a deficient light-sense is severely handicapped in getting about after sunset. (*c*) Consanguineous marriages are common in many parts of the East, and retinitis pigmentosa, and possibly other congenital inherited affections, are relatively common there.

Having thus cleared the ground, we can now proceed to consider the really important element in tropical night-blindness, namely, the widespread occurrence of the condition, which has been variously described as "acute," "idiopathic," or "epidemic nyctalopia."

Epidemic Night-Blindness

This disease has been known from very early times. Ancient records show that it was both recognised and treated centuries ago in China, Japan, Russia, and Turkey (Ishihara). Military history tells of it as a scourge of troops in the field. It attacked Napoleon's soldiers in Egypt, the armies of the Crimea, the British troops in South Africa, and those of all the belligerents in the recent great war. It seems to have shown itself at its worst in the course of sieges, receiving a black mention at that of Malta (1798–1800) and of Damietta (1221) (Meyerhof). It has proved very troublesome to sailors in the Tropics, especially under conditions of bright glare and improper food. In Brazil it is said to be spoken of as "Brazilian ophthalmia." In Japan it is called "Hikan" (Mori), and is there epidemic during the diarrhœa months. In India and other Eastern countries it has occasioned much trouble amongst the jail populations (Buchanan), but is seen at its worst in times of famine, when the rains have failed, and when the meteorological conditions are extremely unfavourable both to eye conditions and to general health. In parts of Russia (Schiele) it is endemic, reaching epidemic proportions in the Spring, at the end of the great fast. There, too, it is found to be most prevalent when the harvest is bad, and it is stated that it may begin with lachrymation and irritation of the eyes. Lastly, farther West it is far from being unknown, and has been described by a number of writers in the British Isles, especially as occurring among school children of the poorer classes, amongst whom it is stated to have a strong tendency to recur, but to be without permanent influence either on the eyesight or the general health (Stephenson).

Signs and Symptoms.—Epidemic night-blindness is a "hot-weather" disease. It is very commonly associated with a xerotic condition of the conjunctiva, and this association has been known as "Bitot's syndrome," in spite of the fact that the first to draw attention to it was a Russian army surgeon, de Hubbenet (Stephenson). Males are much

more frequently affected than females; this may be, and probably is, a question of exposure. All ages are included in its victims, but, in the Tropics, children are certainly the greatest and the most common sufferers.

The **night-blindness** varies enormously in degree; often it is the leading symptom of the case, and the one which drives the patient to seek medical relief, whilst in others it can only be elicited by careful tests. The German surgeons during the recent war relied largely on tests conducted in the dark, with the aid of the so-called radium watch faces, and established an empirical standard by noting the examiner's powers of observation under the same conditions.

Xerosis of the Conjunctiva may occur without night-blindness, or, at any rate, without marked symptoms of it, and it is commonly accepted that there is no inherent relationship between them, other than that they are both due to a common cause. At the same time, they are so frequently found together as to make the syndrome both valuable and suggestive from an out-patient-room point of view. In bad cases, the whole of the conjunctival surface, and even that of the cornea as well, may be affected. In the slighter ones, the changes are confined to that part of the ocular conjunctiva which is exposed when the lids are opened, and which is known as the "interpalpebral zone." Both eyes are usually affected, though not always equally so; on each side of the cornea we see a dry, triangular area, closely covered with tiny particles of dirty white foam, which is soon replaced if wiped away. The appearance, once seen, is unmistakable, and hence is of great value in diagnosis. The conjunctival patches are crowded with a saprophytic organism, the xerosis bacillus. A very different picture is presented in the worse class of case which is encountered with unpleasant frequency in the Eastern epidemics. The whole surface of the eye may be affected, and then assumes a wrinkled, dried-up appearance, like that of a dirty crinkled fabric. On everting the lids, which should be done very carefully, if at all, it is seen that the condition extends to the utmost limits of the palpebral conjunctiva. The corneal affection may be fraught with very serious

results, for that membrane may not merely become dry and opaque, but it may actually slough away, giving rise to prolapse of the iris and disorganisation of the eyeball. In some of the cases hypopyon is very early observed. The corneal troubles are marked by two noteworthy characteristics: (i.) The rapid rate at which the phases of infiltration, ulceration, and perforation are run through; and (ii.) the extraordinary absence of pain or of local reaction. This is all explained by the condition of the children (the victims usually are children), and will best be dealt with under a separate heading.

General Symptoms. — The cases which occur in this country are so mild as to have led some observers to doubt whether a defect in the general nutrition is a causative factor in the case. To those who have seen its Eastern manifestations, a very different view-point is granted, especially in times of famine. Never, whilst memory lasts, can one obliterate the mental pictures of those pitiful little bundles of marasmic, apathetic humanity, lying in the arms of gaunt women, on whose faces and forms famine had laid its devastating hands. Their faint, feeble, fretful wails ring still in one's ears to-day, summoning up visions of wasted stick-like limbs, of distended abdomens, of dry, inelastic, scurfy, scaly skins, of hair scanty, brittle and dry, and of sightless desiccated eyes—the whole blended with the noisome odour of stale urine and fæces, the result of chronic diarrhœa and incontinence. Many of the children are so far gone that the only kind thing to wish them is the speedy relief of death; indeed a large percentage of them would certainly succumb in a colder climate. Others may be in a condition from which they can be rescued with deficient sight or with blindness, whilst others still are cases of a milder type, or in a less advanced stage, for whom much can be done to restore them to their former state of health.

Herbert has called attention to the affection of mucous membranes other than the conjunctiva in these cases. He says: "There are often changes in the mucous lining of the mouth, a husky voice due to changes in the larynx,

nasal catarrh and bronchitis, chronic diarrhœa or dysentery, flakes of cast-off epithelium, as well as pus cells in the urine and slight fever."

The serious corneal condition we have described is usually spoken of as *keratomalacia*, and Koun was probably right when he said that it is not produced by bacteria, but by marasmus ; it is, in fact, a direct manifestation of an extremely bad state of general nutrition, and that is why it so often ends fatally.

Certain other complications have been met with in these grave cases ; they include mumps, adenitis, xerostoma, and sclerotic patches on the vocal cords (Schiele). It is of interest to note that in his admirable paper on British cases, Stephenson stated that strumous children were most affected, and that von Herrenschwand observed enlargement of the lymphatic glands in the neck, axilla, or groin in 51 out of 54 young men in one regiment suffering from war nyctalopia.

It has already been said that there is no necessary relationship between the xerosis and the nyctalopia ; either may occur without the other. Further, it is stated that, in the mild British cases, the proportion of those with xerosis who suffer from night-blindness, varies widely in different epidemics, even in the same place (Stephenson).

Colour Vision and the Visual Fields.—Stephenson noted a reduction of the red and green fields, the red being the more affected of the two, and consequently interlacing with, or lying inside the green. He also observed a slight contraction of the field for white. M. Danis made a similar observation in night-blind soldiers during the recent war ; he found that in most cases the fields for colours were diminished, though they were sometimes normal. C. Hess has devoted much attention to the night-blind, and has found that they suffer from a diminution of sensibility to red, both with spectrum red and with that of a red glass.

The Blood.—Stephenson observed a slight deficiency in the hæmoglobin content of the blood of children suffering from xerosis of the conjunctiva. Dehogues observed a number of cases of night-blindness among charcoal burners

in Cuba, and in every case found that there was a reduction in the hæmoglobin present, together with other characteristics of carbon monoxide poisoning. Von Herrenschwand made a similar observation in the young soldiers whom, as already mentioned, he examined for night-blindness; he reported that the blood showed an increase for small lymphocytes and a decrease of hæmoglobin to 60 per cent. He thought that the slight anæmia present might, when combined with the effects of physical exertion and exposure to bright sunlight, account for the night-blindness.

Diminution of Sensibility to Strong Light. — Hess has observed that nyctalopic patients can look at the sun better than other people, and that they can only see the stars of greater light-strength, such as Venus and Jupiter; they cannot see the less bright stars even with a telescope. This observation recalls a case of quinine poisoning recorded by Nettleship, in which the patient "found that he could stare at the sun without inconvenience" shortly after his vision commenced to return. This was clearly a case of diminished light sense with night-blindness.

Ophthalmoscopic Appearances. — Stephenson observed that in his cases the retinal reflexes were exaggerated, so that the fundus looked paler than usual. A semicircular, jagged reflex was often observed close to the optic disc. Levy had noticed great pallor of the fundus in cases of xerosis with night-blindness. Hepburn did not agree with the observation, but Major Mould, I.M.S., speaking from his Indian experience, said he had seen many cases of night-blindness in enfeebled persons, and all of them showed the intense pallor of the fundi mentioned by Levy. Mikamo, of Japan, found in the eyes of those suffering from night-blindness and xerosis, that there were small fine dots in the horizontal meridian of the fundus; these closely resembled the changes seen in retinitis punctata albescens, but with this difference, that these appearances vanished when the night-blindness cleared up.

Pathology.—**Xerosis.**—The xerosis bacilli are saprophytic organisms, and not the cause of the conjunctival changes. The epithelium is thickened and its superficial

strata form a layer of keratin on its surface. Fat granules cannot be demonstrated with certainty. Beneath the keratin layer is a layer of cells, containing granules of keratin-hyalin. Mucoid cells are conspicuously absent. The essential change is the keratinisation of the epithelium, due partly to exposure and drying thereof, and partly to a deficiency in the lachrymal secretion. The Meibomian secretion, with the bacillus xerosis in it, is simply adherent to these plaques, owing to the altered surface tension brought about by the keratinisation of the epithelium, and by the absence of mucoid changes therein (Mayou).

Of the pathological appearances in the retina we have no accurate records, and must therefore let this subject lie over for the present.

Ætiology.—There is at least one point on which all are agreed, namely, that the changes in the conjunctiva and retina are to be attributed to a common cause. Furthermore, the great majority of those who have interested themselves in the subject, are at one in believing that in this common cause there are two elements—(1) An interference with the general nutrition; and (2) the action of light. We shall probably best appreciate the true position if we look at the case as a whole, considering, as we appear to have every right to do, that the mild cases met with among the poorer children in England, the more severe ones culled from the history of armies, and the terrible ones encountered in the East, are all essentially of the same nature. We find a justification for such an assumption in the fact that, in a single Oriental out-patient room, we may, in the same morning, meet with eyes presenting the very picture that Stephenson saw in a London Poor Law School, with others of hopeless keratomalacia, associated with marasmus, and with connecting links between the two.

The general Nutrition. — Schiele believed that keratomalacia was due to an altered condition of the blood, resulting from impaired liver function, and due to the absence of fat in the diet. He thought that, as a result of faulty nutrition, the mucous membranes were rendered susceptible to the action of weak saphrophytes. Parsons

suggested that malnutrition might lower the vitality of the retina and so delay the processes of repair. Stephenson and Dehogues drew attention to the altered hæmoglobin content of the blood, and Ishihara, whose experience is probably unrivalled, believed that the essential cause of xerosis and night-blindness is an insufficiency in the fat content of the blood ; and this in spite of the fact that the general nutrition of the patient may appear to be good. War, too, has thrown a sidelight on our problem. Many of the writers have laid stress on the physical and moral strain of a great campaign, and have pointed out how intimately this may influence the general nutrition. All that we know of the influence of the mind over the body, and of the action of the secretions of the ductless glands, helps to drive home this lesson. We must now turn to the other side of the case.

The Influence of Light. — From whatever part of the world the reports come, they all agree in this, that xerosis and night-blindness constitute a syndrome only met with in the brighter months of the year. Stephenson suggested that in his cases the greater frequency of the complaint amongst boys was due to the fact that the small British male urchin loves to discard all headgear whenever he can, and is thus more exposed than the girl to the influence of light. The same factor is probably at work wherever the preponderance of males shows itself in this affection. When we come to try and define the cause of the trouble with more precision, our difficulties thicken, but certain indisputable facts stand out as rallying points for the advance of our knowledge. It is accepted by all as an axiom that night-blindness is worse in proportion to the exposure to bright light that the patient has suffered during the day. The most picturesque illustrations of this have been amongst sailors, especially when becalmed in the Tropics, and it is on record that a ship's crew, finding that their work in the day handicapped them for night-vision, adopted the ingenious plan of tying up one eye during the hours of light, and thus preserved it for use at night, whilst its fellow was kept for day-duty.

An interesting point deserves mention here. Braunschweig and others have observed cases of night-blindness in soldiers, which appeared to be brought on by the intense and long-continued demands made upon the visual organs at night under war conditions. We are all of us conscious of the strain of night-gazing, but in many of these cases the trouble is probably associated with equally intense ocular efforts during the day, and also with the results of physical, mental, and moral strain. Writers have speculated on changes in the rods, and of alterations in the formation of the visual purple ; others have suggested that adverse conditions of life have produced the night-blindness by bringing about circulatory disturbances in the choriocapillaris, and so causing a defect in the mechanism of retinal adaptation, whilst yet others have been vaguer still. We cannot follow up any of these speculations with profit, but there is one point on which agreement will be reached by all, namely, that the influence on the retina, of whatever nature it may be, is a product of the activity of the visible rays of the spectrum, since neither the heat rays nor the actinic rays are allowed to pass through the media of the eye.

Diagnosis.—In the great majority of the cases this is a simple matter ; but unfortunately in Eastern countries there are a good many people, who know of the prevalence of night-blindness, and who pretend to be suffering from it, in order to avoid unpleasant duties, or to escape from a service which has become irksome to them. The worst offenders in this respect in India are the sepoys and police. The author has also seen some very interesting instances of feigned night-blindness in persons accused of murder or of other criminal acts. In such a case the defence set up is that it would not have been possible for a person as night-blind as the accused to make his way to a distant spot in the dark, and to commit the crime in question. The best test by far in all such cases is a severely practical one. In Madras the suspect was brought into the dark room and made to sit with his face to the black wall for some time, until he got thoroughly used to the dark ; meanwhile

the work of the hospital went on around him. He was then suddenly bidden to stand up and turn round, and was sharply called to cross the room. Meantime a number of stools had been quietly arranged across his path. If he dodged the obstacles and crossed the room without difficulty, it was clear he was not night-blind to any inconvenient extent. If, on the other hand, he was in danger of falling over the obstacles, he was rescued from doing so by two assistants, one on either side.

Feilchenfeld has employed a useful method in doubtful cases: He keeps the patient in the dark for an hour, and tests the pupillary reaction to weak light stimuli, both before and after such detention, and he finds that in normal people the pupillary reflex is greatly intensified by this treatment, whilst in the night-blind it is not so.

Treatment. — From early times, in China, Japan, and elsewhere, it has been the custom to treat xerosis and night-blindness with extracts of liver combined with honey, and with eel flesh; a more recent substitute is cod-liver oil; those who have had experience of it also speak very highly of eel oil, and the inunction of neat's-foot oil is also greatly praised; but olive oil is said not to be at all of the same value. It is certainly very extraordinary to see how rapidly really bad cases improve under treatment by cooked liver, given in liberal doses, or with the administration of cod-liver oil. The sight by night improves, and cases even of keratomalacia clear up in a way that could neither be hoped for nor anticipated. Schiele quotes one case of extraordinary interest: a nursing mother, with night-blindness and xerosis, had a child with keratomalacia; the former was given cod-liver oil, with the result that both of them recovered rapidly.

The patient should be removed from the surroundings in which he contracted the disease. All sources of nerve exhaustion should be eliminated; his eyes should be protected by Crookes' "B glass," or by detention in the dark for a while if necessary. Attention to diet and rest in hospital are indicated. Jacks has lauded iron as being of even more value than cod-liver oil. Danis recommends

the use of calcium lactate, arsenic, iron, and strychnine, combined with the cod-liver oil. Locally, oily preparations are said to be helpful in the treatment of the corneal and conjunctival condition. Their importance, however, bulks small beside that of the internal administration of cod-liver oil, and of attention to the general health of the patient.

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CHAPTER VII

ERYTHROPSIA AND CYANOPSIA

Coloured vision is more frequently met with in countries where the sunlight is strong than in more temperate latitudes, and in the Tropics, as elsewhere, the majority of the sufferers are those who have had their lenses removed for cataract. Strangely enough, red vision has attracted much more notice than blue, though there is good reason to believe that in the East, at all events, cyanopsia is a very common occurrence; nor is it so rare, as is usually thought, in European cases.

Cyanopsia.—A large number of the patients operated on for cataract in Madras were in the habit of complaining that they "saw everything as if it were blue" after the operation; much more rarely they saw red, yellow, or green. The author therefore took careful statistics of 250 consecutive cases of ordinary cataract extraction, operated on between February 4 and May 13, 1905, and the following table shows the results obtained. As most of the patients were at that time discharged from hospital on the fifth day after extraction, and as their later attendance was often irregular, the observations were limited to the five-day period:

		Per Cent.
Saw white throughout	110	44·0
Saw blue throughout	16	6·4
Began with blue and ended in white	73	29·2
Began with white and ended in blue	10	4·0
Began and ended with white and saw blue in between	19	7·6
Began and ended with blue and saw white in between	11	4·4
Began and ended with blue and saw black in between	1	0·4

Saw red throughout	1	0·4
Began with red and ended in white	2	0·8
Began with red and ended in blue	1	0·4
Saw red, white, and blue in turn	3	1·2
Saw yellow and green	3	1·2
TOTAL	250	100

It will be observed that no less than 53·6 per cent. of the patients saw blue at some time during the five-day period, whilst 2·8 per cent. saw red, and 1·2 per cent. saw yellow or green. The notes were submitted to a very careful analysis from many points of view, but no factor could be discovered to account for the occurrence of the coloration of vision.

The figures were submitted to mathematical examination, and although the results are not sufficiently precise to justify dogmatism, they at least suggest that the tendency to cyanopsia was greater in the decade from 40 to 50 than at any other period of life.

The paper above referred to was published in January 1906, and in the following month Enslin drew attention to the occasional occurrence, in Germany, of the same phenomenon of blue vision after cataract extraction, especially in cases of dense nuclear cataract of long duration. He found that the blue vision usually comes on immediately after extraction, or on the removal of the bandages, and that it lasts for a variable time up to two or three weeks. Though this estimate is doubtless correct for the great majority of the cases, it is not always true that the blue vision disappears so soon and so happily, for the author has seen it last several years in a patient who still had sight with the opposite eye, in which a cataract was also present. That cyanopsia is far from being as rare in England as the mentions of it would indicate, is proved by the fact that the author has seen three cases of it after extraction during the last six years, and in one at least of them the patient had never even visited the East.

Enslin's explanation of this form of cyanopsia was that the dense yellow nuclear mass absorbs all the blue rays for

a long period of time ; then on removal of the cataract the retina is suddenly flooded with long-withheld blue rays, and thus cyanopsia obtrudes itself persistently on the patient's attention.

Sym put the same thought in a different way when, commenting on the author's paper, he said, "In ordinary senile cataract there is a distinct yellow colour ; for some time, therefore, the patient has seen everything through a yellow medium, and when this is removed, objects naturally appear to him as though tinted with the complementary blue colour."

Hess has illumined the subject by his researches on the colour vision of a case with black cataract. He argued that the effect of such a cataract should be the same as that of placing an amber-coloured glass before a normal eye. He found that the patient could not distinguish blue well ; yellowish-green appeared green to her, blue-green she called dark green, blue looked dark grey, and she thought violet was brown or black. Her lens was transparent, but of a deep yellowish-brown colour. Her spectrum was much shortened at "the long wave-end," so that she could not see greenish-blue, blue or violet. In fact, the yellow colour of her lens had become sufficiently intense to make her completely blue-blind.

Cases of cyanopsia occurring in disease are, of course, of quite a different origin, and must be referred to the central nervous system ; such do not come within our purview at present.

Erythropsia. — With regard to erythropsia, it is difficult to speak of its relative frequency in the East and West after operations for cataract, for we have been unable to find any record of a systematic examination such as the writer undertook in India ; but the figures certainly suggest that red vision is more common in the Orient than it is in Europe. This is in accordance with what we might have expected from what we know of the physiology of the subject.

It is a familiar fact that erythropsia occurs in connection with snow ophthalmia, and it has been suggested

that the red vision is produced by the flooding of the eye with ultra-violet rays. In support of this idea it has been put forward that aphakic eyes are liable to erythropsia, that the lens is known to stop the passage of ultra-violet light, and that therefore it is reasonable to attribute the red vision to the greater volume of the ultra-violet radiations which are allowed to pass when the guardianship of the lens is removed. But Vogt has maintained that erythropsia may follow after looking at a snow field through glasses which absorb *all* the ultra-violet rays, and when the rays from the sides have been screened off. He has found that a slight degree of erythropsia is a physiological effect of looking at any strong light, whether from sun glare, from snow, or from artificial illuminants. To demonstrate these lower degrees of the condition, one eye should be subjected to the light and the other kept in darkness, with the view of providing the subject with an unconscious means of comparison. He found that the blue-green rays produce the least erythropsia, and that red-green colour-blind persons experience the same effects as those with normal sight. In a later communication he showed, as a result of experiments, that it is not possible to produce erythropsia, either in normal or aphakic eyes, by the use of pure concentrated ultra-violet light, even when this is of much greater intensity than is found in nature. On the other hand, it may easily be caused in anyone by dazzling the eyes with luminous rays containing green in large quantities, one eye being used as a control. He maintains that the only radiations which can produce red vision, are those whose wave-lengths lie between 500 and 570 microns. He explains the relative frequency of marked erythropsia in aphakic eyes in the following way: Before extraction of the lens, the retina has long undergone a relative dark adaptation; the latter is due to the clouding of the lens and to its amber colour; through multiple reflection, dispersion, and absorption the light reaching the retina of a cataract eye gets, in his opinion, a reddish tinge; and the retina becomes hypersensitive, especially for green light. An important condition for the perception of erythropsia

is the possession of a control eye ; in the absence of such a control, the aphakic subject is as likely to overlook erythropsia as a normal person is.

If this explanation can be accepted, it brings the phenomena of red vision into line with those of cyanopsia. In each case the retina is for a long period dark-adapted, and especially deprived of radiations of one colour ; then, when an extraction floods it with normal light, it shows an acquired hypersensitiveness to those radiations of which it has long been deprived.

Best's work, though more modest in scope, pointed in the same direction as Vogt's more elaborate researches. He dilated one eye with homatropin, protected it with a yellow glass, and exposed himself on a snow field, with the result that he got erythropsia ; he then substituted a blue uviol glass for the yellow one, and repeated the previous experiment ; this time he did not suffer from red vision ; since the uviol glass admitted the violet rays, but stopped the light rays, the inference was obvious.

Verhoeff and Bell, in their more recent researches, support the view, that erythropsia is in no way connected with the ultra-violet radiation, and hold that it is merely an instance of colour fatigue of a temporary character, and without pathologic significance.

It remains to mention that Wydler's work went to show that the erythropsia of dazzling is identical with the red phase of after images, an argument in favour of Vogt's hypothesis.

Treatment.—On this head there is comparatively little to say. From what has gone before, it must be obvious that the only rational line of treatment is to protect the patient from excessive glare by the use of shades and glasses, and to encourage him with the knowledge that the trouble is, in most cases, a very temporary one. In the few rare cases where it is long continued or recurrent, it should be pointed out to him that when the second cataract is extracted, the trouble will probably disappear spontaneously with the removal of the control, which is being exercised by the second eye so long as it possesses a lens.

As to the best form of glass, it is obvious that those varieties which, like Crookes', cut off the ultra-violet radiations, are not indicated. What is needed is uviol blue glass, or, better still, the neutral tint, or smoked glasses, which cut down the volume of light rays entering the eye.

Von Reuss has advocated the use of the Faradic current in the treatment of erythropsia: but as he only tried it in four cases, and failed in two of them, and as the rationale of the treatment does not seem very obvious, the advice is possibly of doubtful value.

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SECTION III

THE EFFECTS OF EXPOSURE OF THE EYES TO WIND AND DUST IN TROPICAL COUNTRIES

Chapter I. Introductory.

,, II. Pinguecula and Pterygium.

,, III. The Causation of Epidemics of Ophthalmia in the East.

CHAPTER I

INTRODUCTORY

It is very difficult for anyone, who has not actually lived the whole year round in a tropical country, to appreciate the influence of heat, wind, and dust. The minds of those of us who have done so, go back to those first days of each year, when the covers of the books on our shelves began to curl up backward, when, as we emerged from our bungalows, the heat of the breeze struck like a blow, painfully drying up the skin, and suggesting a blast from a furnace. Indeed, it is apt to provoke in the mind of the tired official a comparison with one furnace in particular. Then, as the year moved on in a succession of days, each one of which seemed hotter than the last, every blade of grass disappeared from our compounds (gardens) and from the maidāns (commons), till the earth's surface assumed one brown, baked hue, variegated only by the interlacing, gaping cracks in the soil. The dust-devils, dancing down the road, and the blinding storms of wind, charged with desiccated and fæces-laden earth, come back to memory like the incidents of an evil dream. In the absence of a fan, sleep was impossible, or, at the best, feverish and uneasy. In the morning one longed for the night, and at night one cried with the Psalmist, "Would God it were morning!" How can anyone, who has not actually experienced tropical conditions, rightly appreciate the long weary struggle that goes on between the human powers of endurance, on the one hand, and atmospheric conditions, to which the term "hellish" is habitually applied, on the other. The longing for rain becomes an obsession, and the first smell of it, as it is wafted from a storm miles away, is a sensation one will forget only with death, for it is the harbinger of the

end, for that year at least, of drought and dust. And that dust! Nothing will keep it out; broad verandahs, jalousies, and chicks do their share to make life tolerable, but it will take no denial; it insinuates its hateful self into every interstice of your life and belongings; it flavours your food with the fæcal smell of the East; it fills your eyes with grit, and it drives you to live as large a part of your time as possible in a bath. It is not strange that such conditions should affect the eyes, nor that they should most powerfully affect those portions of the cornea and conjunctiva which are freely exposed in the palpebral slit. The dust penetrates far back into the conjunctival sac, but is constantly swept into the palpebral fissure by the current of the tears and the movements of the lids; there it accumulates in quantity, thus irritating the exposed parts to a maximum. The result is the production of pingueculæ and pterygia: we shall return to consider these growths more fully in a later chapter.

It is not difficult to understand that the heated winds of a tropical country, blowing, as they often do, over vast dry areas, have a desiccating effect on the lining epithelium of the cornea and conjunctiva; the consequence is a strong tendency to exfoliation of the protective cells, which favours the production of superficial ulceration, and predisposes the eye to infection from without.

Anything which involves rapid movement through the air is prone to intensify the effects of the evil influences we have been discussing. Thus, eye troubles are not uncommonly met with in those who ride horses fast, for example, those who take part in races, steeplechases, paperchases, and hunting. Motoring is still more dangerous, on account of the longer exposure of the eyes it involves. A large number of motorists in the East wear goggles, and it is quite certain that all should do so, whether they are actually driving or not. If this rule were carried out, a large number of eye cases would be eliminated from the ophthalmic surgeon's visiting list. In making this fact known, he will be acting from altruistic motives, and in the interests of preventive medicine. It is anticipating a

point which we will have to come to later in the book, but it is à propos to mention that the protection of the eyes by glasses saves them, not only from the dangers we have been discussing, but also from the other very real ones due to flying insects.

Many patients in the Tropics bewail the aggravation of their eye troubles in the afternoons. The writer had heard such complaints for years, and had put them down to fancy, until he himself suffered from granular ophthalmia ; then he found that, with clockwork regularity, his eyes became additionally troublesome between four and five o'clock each afternoon. He did not take long to recognise that the onset of the aggravation of his eye symptoms was synchronous with the arrival at his bungalow of the hot sea breeze, which, to reach there, had first to travel over several miles of dry, baked country. This furnished the key to the complaints which he had not understood before, and threw a valuable light on the importance of protecting all cases of conjunctival and corneal disease from movements of air in the East.

There is still another point which we have repeatedly referred to, but which deserves fuller notice, namely, the presence of dried fæcal matter in the dust of tropical countries. A large proportion of the natives defæcate in the open air. The practice is filthy, insanitary, and dangerous, but it is robbed of much of its worst terrors by the action of the sun's rays. Were it not for this factor, it would be difficult to understand how life could be maintained at all in the East. At the same time, the dried, powdered fæcal matter, lying about everywhere, impregnates the whole of the dust of the Orient, and imparts to it the sickly, offensive odour with which we all become so familiar. Very few, even of the residents, appreciate how much dust the air contains, but at certain times of the year anyone, standing on a high building, can look down and see with ease that the atmosphere, even to the heights of the tops of the ordinary houses, and higher still, is bathed in a sea of dust, which is densest near the earth, and thins away higher up. Such a spectacle teaches one how universal

the impregnation with dust can be, and points to the dangers attendant in its train. It is, however, after one of the first showers of the year that we best appreciate the fæcal condition of the atmosphere, when the faint, sickly smell of a latrine pervades all nature, and robs us of much of the pleasure that we derive from the welcome advent of the longed-for rain.

CHAPTER II

PINGUECULA AND PTERYGIUM

We have shown in the previous chapter that the portion of the conjunctiva, which lies exposed in the palpebral fissure, is especially liable to chronic irritation, as a result of the combined action of dust, wind, heat, and glare. The fact that the stream of the tears, carrying its freight of dust to the lachrymal passages, always sets inwards to reach the canaliculi, naturally ordains that the greatest stress of the irritation shall fall on that portion of the conjunctiva, which lies internal to the cornea. It is for this reason, that both pinguecula and pterygium are more often found on the inner than on the outer side of the eye. In hot, dusty countries these little growths are very commonly met with, whilst in Europe they are comparatively rare. Indeed, when one sees one of them in London, one is almost safe in assuming that the patient has lived for some time in a tropical, or, at any rate, in a dusty climate.

PINGUECULA

As a result of a chronic congestion of the interpalpebral fold of the conjunctiva, often one of the first changes to be observed is the formation of small yellow thickenings of the membrane, most frequently met with on the inner side, but not rarely on both. As time goes on, these small thickenings coalesce, to form a broad thickened band, which extends from the cornea to one or both canthi. The conjunctiva, over such an area, loses its normal transparency, becomes more prominent than natural, and shows evidence of chronic congestion. The appearance is so characteristic as to be unmistakable. The name pingue-

cula (*pinguis*, fat) was given owing to the mistaken idea, that the yellow colour was due to the deposition of fat in the conjunctival membrane. It has, however, long been known that this coloration is really due to an increase in the number and size of the elastic fibres in the subconjunctival tissue, associated with the deposition there of numerous concretions of a yellow hyaline substance. If pinguecula does not actually pass on to be transformed into pterygium, the clinical history of many of the cases must be very misleading, for it is quite certain that where a pinguecula has been present, a pterygium often makes its appearance later. It is, of course, possible that this is a coincidence to be attributed to the fact that the two have a common cause.

Treatment. — Most of the patients, who consult a surgeon for pinguecula, will be satisfied by his assurance that the neoplasm has no serious significance, and will be content to take the advice to let well alone. There are, however, a certain number, who, from vanity or other motives, will desire to be relieved of what they consider a disfigurement. In such cases excision may be performed, and is a very easy operation. If, however, the eyes continue to be exposed to the same adverse conditions as before, a recurrence of the growth is not unlikely.

PTERYGIUM

A pterygium is a triangular fold of altered conjunctival tissue, with its apex on the cornea and its base toward one or other canthus. The former is commonly spoken of as the *head* of the pterygium, and that portion lying on the conjunctiva as its *body*. Close to the corneal margin a probe can be passed for some distance upward or downward under the growth ; this part is known as the *neck*. It is not possible to pass the probe right through the fold at this part in a true pterygium, though this may be done in what is spoken of as a false pterygium ; in the latter a fold of conjunctiva has become attached to a raw surface near the corneal margin, and the pathology is therefore quite

different from that of the true growth, which we shall discuss shortly. The natural tendency of a pterygium is to continue to grow, and, in so doing, to invade the cornea over a wider and wider area. A growing, or progressive pterygium has a fleshy head and is usually distinctly vascular ; numerous blood vessels can be seen in its substance, and the conjunctiva covering it loses its natural transparency and often its lustre as well. In addition, the surface of the growth has a radially furrowed appear-

Fig. 8.—Double Pterygium, right eye. The inner is the larger and nearly covers the pupil. (Supplied by Lt.-Col. H. Kirkpatrick.)

ance, owing to the drag on it, as it advances. The plica semilunaris is often involved in the body of the pterygium and so quite obliterated. This may lead to considerable disfigurement of the eye, as well as to marked limitation of movement. The latter may be so pronounced as to cause distressing binocular diplopia. Sometimes during its progress the head remains narrow and pointed, but much more frequently it widens out, and often very irregularly so. In any case, it continues to advance over the clear cornea in the direction of the pupil. It may indeed

pass right over the pupillary area, and extend nearly to the limbus on the opposite side from that on which it started. As has already been said, pterygia are much commoner to

FIG. 9.—Pterygia of outer sides of both eyes, a rather uncommon condition. Note that that on the left eye has extended beyond the pupil, which it has completely covered; that on the right side leaves only a small part of the pupillary area uncovered. (Photo supplied by Lt.-Col. H. Herbert.)

the inner side of the cornea, but they may be met with on the outer side alone, and very often indeed growing from both sides at once. In the latter case, if they are uninterfered with, they may meet in the neighbourhood of the

PLATE II

A pterygium growing from the inner side, and extending almost completely across the cornea.

(Painting supplied by Lt.-Col. H. Kirkpatrick, I.M.S.)

pupillary area. There are two points that the tropical practitioner should grasp clearly—(1) Any portion of the cornea which has once been invaded by one of these growths will never regain its transparency ; it will for the rest of life remain leucomatous, and practically useless for clear vision. (2) The actual boundary of the growth is always materially in advance of the line indicated by a naked-eye inspection. The use of a loupe, with the aid of oblique illumination, will easily demonstrate this point. The clinical significance of these observations is as important as it is obvious. (Figs. 8 and 9 and Plates II. and III.)

Under favourable conditions, and if the source of chronic irritation is removed, the growth of a pterygium may cease spontaneously ; it then becomes avascular, and the conjunctiva with which it is covered may regain much of its transparency, while its head instead of being fleshy and prominent becomes thin and membranous.

Rarely, pterygia will be found growing in other quadrants beside the two mentioned, and still more rarely, cases will be met with in which they grow from many directions at once, invading the cornea from all sides. Such are very troublesome to treat, and the growths show a great tendency to recur, and finally to blind the patient. For this class of case, the author has suggested the term " malignant pterygium " ; it at least expresses the clinical course followed by the growths.

It is not infrequent to find a certain amount of catarrhal ophthalmia in association with the presence of a pterygium. This is most marked over the body of the growth, but may affect the conjunctival membrane generally.

The two eyes are frequently affected together by pterygium, and in Eastern countries the surgeon will often be called upon to operate for a double pterygium in both eyes at the same time.

Pathology.—Histologically, a pterygium consists of an extension of the subepithelial, vascular, connective tissue of the conjunctiva inward between the corneal epithelium and Bowman's membrane. The latter structure is

destroyed where it lies beneath the pterygium, and so also, to some extent, in advanced cases, are the uppermost lamellæ of the cornea. New-formed tubular glands and larger spaces lined with epithelium are found in the substance of the growth. Their presence explains the cysts which we not uncommonly find in connection with pterygia. (Plates III. and IV.)

Treatment.—If there is any catarrh accompanying the pterygium, this may be treated on ordinary lines. A great deal may thus be done to add to the patient's comfort. If, however, the growth is extending over the cornea, the sooner it is operated on the better, and the urgency increases in proportion as the neighbourhood of the pupillary area becomes in danger of invasion. Another point to remember is, that the earlier the operation, the smaller is the mass to be dealt with, and the more satisfactory will the results of operation prove. On general principles, it is obviously unwise to perform any operative procedure on an inflamed eye, and, therefore, if marked evidences of inflammation are present, it is well to undertake a few days of treatment with argyrol, or with silver nitrate, before bringing the patient on the table.

As to the choice of operative procedures: For small early pterygia, a *simple excision* will amply suffice, care being taken to drag the head of the growth off the cornea in order to remove it as completely as possible in this region. The conjunctiva should be detached from the limbus for a short distance upward and downward, and should be undermined sufficiently to allow the edges to meet freely and easily in the horizontal meridian, and thus to close in the raw surface of the wound as completely as possible.

For larger growths, some method of transplantation is advisable. The author practised a method of his own for many years on a very large number of cases in Madras, until he met with McReynolds' modification of it. The latter is so satisfactory as to be almost ideal.

McReynolds' Operation.—(1) Seize the neck of the pterygium with strong but narrow fixation forceps, and dissect the head of the growth off the cornea with a Graefe knife or

PLATE III.

Pterygia growing from inner sides of both eyes. The right growth shows cyst formation. The pterygia had been noticed for ten years, and the cyst, which was increasing in size, for six months.

(Painting supplied by Lt.-Col. H. Kirkpatrick, I.M.S.)

PLATE IV.

A large cyst in connection with a pterygium on the inner side of the right eye.

(Painting supplied by Lt.-Col. H. Kirkpatrick, I.M.S.)

with sharp-pointed scissors, being careful whilst doing so to tear the head of the pterygium forcibly away from its insertion into the cornea ; in this way the fibres of the growth are separated from those of the cornea as completely as possible. (2) Still holding the pterygium with the forceps, divide the conjunctiva and subconjunctival tissue with slender straight scissors along the lower margin of the pterygium from its neck right out to its base (Fig. 10). (3) Separate the body of the growth completely from the sclera by dissection with scissor-points. (4) Make

FIG. 10.—Early stages of McReynolds' Operation ; *f*, forceps ; *kn*, scissor points.

a deep pocket downwards, by dissecting with blunt-pointed scissors between the conjunctiva and the globe as far as the fornix. (5) Take a black silk thread, armed at each end with a small curved needle ; pass the needles through the head of the pterygium, then down into the pocket and out through the conjunctiva ; they should emerge near the lower fornix about one-eighth inch from each other (Fig. 11). (6) By a gentle pull on the two ends of the suture, slide the loosened pterygium into the pocket, lifting up the freed lower segment of the conjunctiva to do so. (7) Fix the pterygium in place by tying the ends of the suture together and apply light dressing. Remove the

stitch on the sixth day. For a very full description of the procedure the reader is referred to McReynolds' original article (*The Ophthalmoscope*, 1914, vol. xii. p. 134).

When two pterygia are to be transplanted at the same time, the author suggests the following modification of the procedure as one which he has long found satisfactory. The first three steps of the operation are as before. (4) A pocket is made on each side so that the two meet in the middle line; in other words, the whole of the lower part of the bulbar conjunctiva is dissected up to form one space, into which it is designed to draw the two pterygia, one from

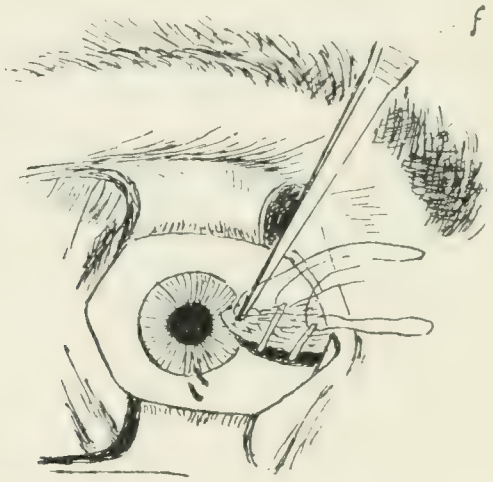

FIG. 11.—McReynolds' Operation; method of applying the sutures; *f*, forceps.

each side, making them meet in the middle line. (5) Take a long black silk thread, armed with two needles; (i.) pass one needle through the head of the pterygium on the inner side (Fig. 12 *i*), and carry it round beneath the conjunctival flap to emerge at the opening of the pocket on the outer side; (ii.) pass it on through the head of the pterygium on the outer side (*o*), and carry it back again inside the conjunctival pocket to emerge at the point (*a*) close to the fornix, below the cornea and just to the outer side of the mid-line of the eye; (iii.) pass the second needle beneath the conjunctival flap to a point (*b*) just opposite to that of the final emergence of the first needle, but one-eighth inch from it and to the inner side of the mid-line; (iv.) by a gentle

pull on the two free ends of the suture, aided by the use of forceps, direct the pterygia into the pockets from above; draw the two growths almost to a meeting-place beneath the

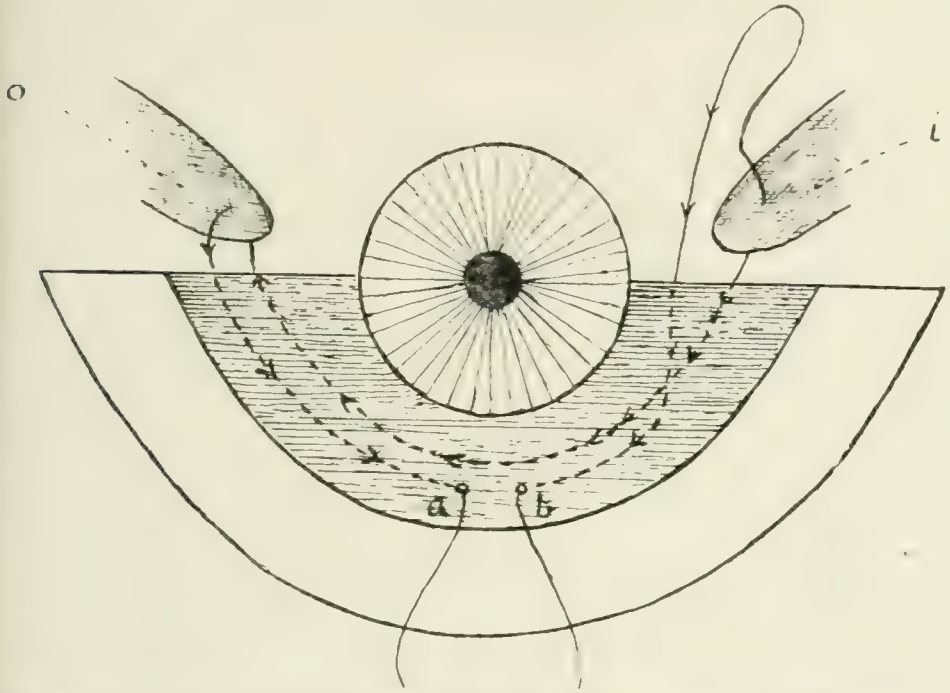

FIG. 12.—To show the course of the two ends of the suture in the operation for double pterygium. Notice the lines of the arrows, which show the direction in which the sutures are passed. The pocket made beneath the conjunctiva is shaded in the diagram; *i*, head of inner pterygium; *o*, head of outer pterygium; *a*, point of emergence through the conjunctiva of the long end of the suture; *b*, ditto of short end.

flap; smooth them out with the aid of a director or curette, and tie the stitch.

In the case of comparatively small pterygia, it is not necessary to tunnel right through from side to side, and each growth can be buried in its own pocket. Some surgeons may prefer to adopt this method even with the large growths.

CHAPTER III

THE CAUSATION OF EPIDEMICS OF OPHTHALMIA IN THE EAST

There has, for a long time past, been a widespread belief that the wind and dust of tropical climates is responsible for the sudden epidemics of ophthalmia, which are met with annually at certain seasons. The commonly received explanation, formerly, was that the causative germs were carried in the dust of the atmosphere by the prevailing winds, and that in this way a direct conjunctival infection took place. Collins has, however, pointed out that most of the organisms which set up ophthalmia are of the non-sporing kind, and are known experimentally to be easily killed by drying. He has also suggested that the filthy water of the Eastern baths, saturated as it is with organic animal matter, may prove a medium for the spread of conjunctival disease. The Klebs-Loeffler bacillus is capable of withstanding drying, and can probably also multiply in water of the kind above described, but it is responsible for only a very small percentage of the Eastern ophthalmia cases.

The gonococcus, which according to Meyerhof is responsible for 20 per cent. of the Egyptian cases, dies very rapidly when removed from the human body; indeed, it has so little vitality, under these circumstances, that its cultivation, even in a laboratory, is a difficult matter, and it would certainly not survive either being dried or being immersed in water. The Koch-Weeks bacillus, which Meyerhof states is responsible for 62 per cent. of the Egyptian cases, the Morax-Axenfeld bacillus, the *Bacillus coli communis*, the pneumococcus, the staphylococcus and the streptococcus, would certainly all die rapidly if dried in

sunlight, and would probably soon succumb to immersion even in very dirty water. Indeed, the two first on the list, which are far the most important from our present point of view, are well known to be difficult to cultivate even under the most favourable circumstances.

The conditions under which the epidemics arise have been very carefully studied in Egypt by McCallan, Meyerhof, and others, and have also been investigated in Madras by the author, but it cannot be said that any finality in our judgments has been attained. The evidence is negative rather than positive, and a wide field for investigation is still open.

Meyerhof found that, with the exception of the diplobacillary conjunctivitis of Morax-Axenfeld, all the forms of acute ophthalmia in Egypt (inclusive of those of gonococcal, Koch-Weeks, streptococcal, pneumococcal, and diphtheritic origin) increase during the summer and acquire an epidemic character at that season. Lakah and Khouri have noted that in Alexandria the Koch-Weeks epidemic appears before the gonococcal, the former attaining its maximum in June, the latter in September. Meyerhof verified these observations, with the exception that he found that, in Cairo and Upper Egypt, the Koch-Weeks conjunctivitis attains a primary acme in May or June, and a second in September or October, the latter being concurrent with that of the gonococcal epidemic. In December, the curve of incidence falls, and only sporadic cases occur until the first days of spring. This sequence is repeated yearly with astonishing regularity, the epidemic varying, however, from year to year in its virulence.

Meyerhof studied the epidemics by the graphic method, taking three curves for the purpose—(1) The incidence of the cases ; (2) the average temperature in Cairo ; and (3) the rise and fall of the Nile. He was able to show that neither the variations in the height of the river water, nor the hygrometric state of the air, nor the variations in the intensity of sunlight could be held accountable. He was also disposed to exclude the influence of dust, on the ground that, in the harems, from which both dust and light are

rigidly excluded, gonorrhœal conjunctivitis is much more prevalent than it is in sunlit and airy rooms. He also points out that no cases occur in February and March, when the dusty winds are prevalent, and many in autumn, when the power of the sun is waning.

On this point the author would like to offer an observation of some importance, namely, that if we wish to find sun and wind at their worst, we must look for their effects when they act concurrently. As has already been pointed out in the introductory chapter, the most severe trial of the human eyes or skin takes place at a time when the air is hot, in rapid motion, and full of dust. Competent bacteriologists hold that even so virulent an organism as the gonococcus may be applied to a mucous membrane, and may remain freely in contact with it, without necessarily infecting it. A certain amount of friction appears to be necessary unless abrasions already exist. The same would appear to be true of many other organisms. Now we know the desiccating influence on the conjunctival epithelium of the combination of sun, wind, and dust, and it needs no argument to prove that this triad of evil influences may readily pave the way for the infection of the membrane, through the agency of any or all of these organisms.

On the other hand, the above argument will not explain why one form of epidemic precedes or follows another, and the author has long been in close agreement with Meyerhof's proposition, that until we understand the conditions of viability and germination of the various kinds of bacteria outside the human body, we shall be at a loss to explain the regularity of incidence and the variability in virulence of epidemic conjunctivitis in Eastern lands.

We know that each organism has peculiarities of its own; its growth is influenced by the nature of the medium in which it finds itself, by the temperature of the air, and probably also by many other factors, not excluding the hygrometric one, of which we have little knowledge.

To summarise: There are two great influences to be considered—(1) That of the conditions which prepare the conjunctiva for infection; and (2) that of those which

stimulate the causative organisms to rapid and pathologic proliferation. These are the really big things, and all others sink into insignificance in comparison with them. All the same, before leaving the subject, we may with profit consider some of the subsidiary factors at work.

Flies.—Much stress has been laid on the part alleged to be played by flies in Egypt. Few things in that land arrest the visitor's attention more forcibly than the sight, familiar in every bazaar, of the children, whose inflamed eyes are black with preying flies. He naturally argues that these insects must carry the organisms, causative of inflammation, to other and healthy eyes. The statement which has been made, and which also unfortunately has been widely accepted, that flies do not enter or touch the healthy conjunctival sac, is absurd; any surgeon who lives in the East knows the persistency with which certain flies will endeavour to settle on his conjunctiva during an operation, taking advantage of the fact that the rules of asepsis prevent him from defending himself against their unwelcome attention. This was so annoying to the author that, when operating in Madras, he had a fly-flapper kept handy, so that an assistant could kill these pests for him when they became troublesome.

The experiment has been made of allowing house flies to alight upon a cultivation of the *Bacteria prodigiosa*, and afterward to walk across freshly prepared plates of nutrient gelatine, with the results that their tracks on these plates later on became marked out by streaks of the red growth. Many other similar experiments of an even more convincing nature have been carried out. Thus, house flies have been accused of being transmitters of diarrhœal diseases, plate cultures from dirty dwellings showing a much higher count than those from clean houses. F. W. Thomson investigated the rôle of these insects as carriers of typhoid infection; they can retain living typhoid bacilli within their bodies, and can transmit the infection for twenty-four hours after ingestion; moreover, they can carry the living germs on their feet, or on the exterior of their bodies, for six hours, and so can prove infective throughout

this period. Bahr, working on dysentery in Fiji, stated that there was strong presumptive evidence that house flies were the principal agents in the spread of the disease; whilst J. F. Taylor has recently (October 1919) confirmed this opinion, and shown that these insects convey both the Flexner and Shiga bacilli; the danger is at its greatest shortly after the fly has settled on infected material, and diminishes rapidly until, after twenty-four hours, it is comparatively slight.

It is true that Meyerhof examined the flies buzzing round a patient with ophthalmia, and that he placed them in culture tubes without any positive result. It is also on record that he never found the gonococcus or the Koch-Weeks bacillus on the probosces or feet of such insects; but such negative evidence cannot be allowed to carry much weight in view of the facts we have already reviewed, and of many others of a like nature which space forbids our mentioning.

On the other hand, there is a point which we must not forget, namely, that in India, at least, the ordinary house fly dies out, or becomes very sluggish and scarce during the hot weather, and can therefore be practically excluded as a factor of any importance in the causation of ophthalmia epidemics there. It may be an occasional carrier in India; it is certainly not one of the main influences in the spread of these epidemics.

The Eastern Cosmetic Pot. — An Eastern house is like a rabbit-warren. It is idle to expect anyone, who has not worked among the better classes in the East, to appreciate this statement. The surgeon, who is called in to see a patient in a well-to-do house, is led through a succession of passages, and, if it is a big house, of courtyards as well. The place is alive with women, children, and servants. The patriarchal system of related families living together is responsible for this. All the women and children use cosmetics if they can afford them, black antimony being one of the constituents. The cosmetic pot is common to the house; the child with sore eyes is beautified along with the rest of the Family, spelt with a big F.

The possibilities of infection of the cosmetic pot, and of the immediate transference of its dangerous material to the next in turn, by means of the feather, the brush, or the fingers, are obvious. Granted that the two prime conditions we have laid down are at the time in being, we can see how very powerful a factor the cosmetic pots of an Eastern land may be in the spread of conjunctival epidemics.

The Ignorance and Callousness of the People. — During an epidemic, and at other times as well, it is a common occurrence, in an Indian out-patient room, to see a mother wiping away the purulent secretion from a child's eye with her fingers or thumb, without making any effort to cleanse her hands after doing so ; at the most she may wipe the secretion off on the nearest fold of the cloth, which covers her shoulders or loins. A few moments later she may be observed rubbing her own eye, where perhaps a fly has settled on it, or else attending to the eyes of another of her children. The lesson is obvious.

A very extraordinary superstition deserves a mention in this connection ; it is connected with the use of a saffron-coloured rag. Many of the people carry such a rag, under the belief that, since the pus is yellow and the rag is yellow, and since, therefore, the former cannot be seen on the latter, there can be no danger associated with its use. It is the story of the ostrich and the sand, enacted by human beings with lamentable results.

In conclusion, just a word on these waves of epidemic met with in the East. In a single morning's out-patient experience in a large Indian hospital, 50, 60, 70, or more new cases of epidemic ophthalmia will present themselves, and the surgeon in charge cannot be too careful to impress upon his assistants the necessity of washing their hands after dealing with each and every individual. The author gives this warning after having often seen so elementary a precaution absolutely disregarded by those who should have known better.

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SECTION IV

INJURIES INFLICTED ON THE EYE BY ANIMALS IN THE TROPICS

PART I.—GENERAL CONSIDERATIONS.

PART II.—INJURIES BY FLYING INSECTS.

Introductory.

Chapter I. Mechanical Injuries.

„ II. Chemical Injuries.

(A) When the insect actually enters the conjunctival sac.

(B) By parts shed from insects.

(i.) Ophthalmia Nodosa.

(ii.) The Yellow Moth.

(iii.) Fumuski Blennorrhœa.

(C) By vegetable matter, carried into the sac by insects.

„ III. Septic Infection due to Insect Agency.

PART III.—CHEMICAL INJURIES BY OTHER ANIMALS.

Chapter I. Ascaris Poisoning.

„ II. Eel's Blood Conjunctivitis.

PART IV.—INJURIES BY STINGS AND BITES.

Chapter I. Wasp and Bee Stings.

,, II. Mosquito Bites.

,, III. Ant Bites.

,, IV. Tick Bites.

,, V. Injuries by other Poisonous Arthropods.

,, VI. Leech Bites.

,, VII. Miscellaneous (Chicken Pecks, Rat Bites, Attacks by Snakes, etc.).

PART V.—THE INVASION OF THE LIDS AND EYES BY SMALL ARTHROPODS.

PART I

GENERAL CONSIDERATIONS

The man who has lived all his life in Europe, has but a poor and second-hand conception of the superabundance of lower animal life, which is to be found at favourable seasons in many parts of the Tropics. Those who have seen the swarming of a cloud of butterflies, whose dazzling wings paint a wide stretch of road, field, garden, or jungle with their own brilliant hues, are never likely to forget the scene. The prevailing impression is that of a kaleidoscopic glittering, moving mass of blue, red, yellow, or purple, or of some subtle blend of these or other colours, revealing nature in its most prolific mood, and suggesting possibilities which would never otherwise have occurred to the observer.

Again, an experience of a swarm of white ants is one which the memory will long retain. After a shower of rain these insects start their hymeneal flight, in the course of which, attracted by the lights, they make their way into the nearest houses, where they rapidly shed their wings until the floors are littered with them ; special covers have to be provided for the protection of the food at meals, and the ground is literally alive with these crawling insects, now deprived of their powers of flight, and actively engaged on the marital business of their short existence.

Or again, it will be the green bug which is swarming, and the rider or pedestrian, who passes by the trees in which they are buzzing in their tens of thousands, can smell from afar the disgusting odour, which they share with the bed bug. The danger of these pests getting into the conjunctival sac is at such times a very real one. This matter will be mentioned again later.

Scarcely less unpleasant is the tiny "eye-fly," widely met with in the plains of the Deccan and in many other hot, dry, Eastern countries. The insects are so small that they pass with ease through the mesh of an ordinary mosquito net; they appear to be powerfully attracted towards human beings, round whose heads they swarm in a dense black cloud, and into whose eyes they make the most persistent efforts to enter.

Then there are the bees and wasps, many of which excavate their nests in the beams of Eastern houses, or suspend them on the trees, or hide them in the clefts of the rocks. Whatever may be the choice of their abode, they will bitterly resent interference, and many an unwary man, who has unwittingly disturbed them, has paid the penalty of his rashness with his life.

The hum of a mosquito is so constant an element of Eastern life, that, like the throb of the screw on an ocean voyage, it is almost missed when it ceases. To the newcomer in the Tropics these animals are a veritable plague, often covering him with irritating, and even with festering sores. The old resident usually finds evidence of their attentions only in small red dots on the exposed portions of his body; but, if the animal has been feeding on foul or septic material, even the most hardened may find the resulting bite painful, or even dangerous.

In many parts, ticks of all kinds and sizes seem to cover the earth. Animal pets have to be constantly watched and these pests removed from their skin, whilst man is far from immune from their attacks, especially when living under the dirty and insanitary conditions so prevalent amongst Eastern peoples.

How many of those who live in Europe have any conception of what the ant is in tropical lands? Drop a little sugar from your afternoon tea, and as if by magic a column of these insects will appear, will sweep it up, and will then vanish as silently and mysteriously as it came. Let some small animal die, and as if by the wave of a wand, an ant-army is mobilised from nowhere, and will not rest until it has removed every vestige of flesh from the bones;

but this is not all ; many of these creatures nest in trees or bushes, and woe betide the man who accidentally knocks against their homes. Then, what shall we say of the great columns of these insects, which flow for hours in wide procession through a tract of country, carrying everything before them ? To turn them is next to impossible ; the wise man bows to fate, and clears out of the way till the malignant animal torrent has flowed past.

Nor is it only the insect that harries the resident in the Tropics. Other Arthropods take their share in his discomforts. The class of Myriapods contribute the centipedes and millipedes. The former make themselves at home in the houses, whilst a sight of the latter, forming a solid, crawling mound on the garden paths, is an education in itself. Then there are the Arachnids, contributing the poisonous spiders, as well as the scorpions and the mites.

These remarks merely constitute a short résumé of an enormous subject. They are not designed as a list or category of noxious animal life in the Tropics, but merely as a word-picture, all too feeble, whose object is, in some faint measure, to express the possible dangers that man runs in these countries from the attentions of certain groups of the lower animals.

What strikes the medical man at first as extraordinary, is that the tropical literature of eye trouble from this source is so meagre and scanty ; but the explanation is not far to seek. Men write but little of the occurrences of everyday life. Incidents which seem astonishing and interesting to a visitor to the Tropics, have become vulgarised to the resident by everyday repetition. Indeed, the fact that the records in literature of eye troubles from insects and their allies are so few and far between, is to be explained, not by the paucity but by the abundance of these minor afflictions.

As so much has been said about the Arthropods, it seems desirable to enumerate some of the most important subdivisions of this phylum.

Class I. Crustacea, including cray-fishes, crabs, etc. ; these are of comparatively little interest to us.

.. II. Onychophora.

Class III. Myriapoda, including the centipedes and millipedes.
„ IV. Insecta, including locusts, flies, beetles, butterflies, and bees.
„ V. Arachnida, including spiders, scorpions, and mites.

It will be convenient to include in this section certain other animals, which, from time to time, prove injurious to man, despite the fact that their zoological position is very different from that of the Arthropods.

PART II

INJURIES BY FLYING INSECTS

INTRODUCTORY

After a heavy fall of rain in the Tropics, winged insects hatch out in numbers which must be seen to be believed. Whilst riding or driving, or even whilst walking, through such swarms, a man is very apt to get one or more of these animals into his eyes, especially if his eyelashes are weak and scanty. But, even apart from such easily recognisable accidents, the swarms may be pregnant with danger to human beings by the particles which they shed from their own bodies into the atmosphere, or by the introduction of vegetable and other matters, which they fortuitously carry with them from one alighting place to another in the course of their flights.

The injuries inflicted may be of several different kinds—(1) *Mechanical*, due to the presence of the mass of foreign matter in the conjunctival sac, or merely to the force of the insects' impact against the globe ; (2) *Chemical*, due to irritant secretions or particles furnished by the unwilling guests ; and (3) *Infective*, the animals merely serving as the transmitters of septic material. Each of these must be considered in turn.

CHAPTER I

MECHANICAL INJURIES INFLICTED BY FLYING INSECTS

At certain seasons of the year, in tropical countries, the *house fly* "is a burden," compared with which the importance of the grasshopper of Ecclesiastes must fade into insignificance. The statement has been made that these diptera never attempt to enter a healthy conjunctival sac. The absurdity of such a suggestion is only too well known to all who have lived in Eastern countries; but, apart from the deliberate and frequent invasion of the eye by these pests, they are only too often forced into it accidentally by the impetus of their flight, by the wind, or by the rapid movement forwards of the owner of the organ, especially when the latter is riding or driving.

Then there is "the *eye fly*" (*Siphonella funicula*) of the Deccan, and of many other dry, dusty, Eastern climates. In the hot weather these tiny pests invade the houses in thick black clouds; no mosquito-net will keep them out, and the persistence with which they endeavour to commit suicide in the moist folds of the human eye is extraordinary. The natives hang up the boughs of the milk-hedge plant (various species of Euphorbia) in conspicuous places, and on these the flies settle, to the great advantage of their human victims; a number of them can be drowned by suddenly plunging the bough into water; this is done by bringing the water in a pail up over the bough from below.

The *white ants* furnish another instance of swarming insects which are, for the time being, all pervading. They are unpleasant when they get into the mouth, nose, or ears, or down one's clothing, but they are worse than unpleasant when they find their way into the eyes.

These are but examples of some of the less harmful of the flying pests of the Tropics. Each land has its own story of the same kind to tell, with differences in the genera or species concerned, but alike in its main outlines.

Allusion has elsewhere been made to the report emanating from South America of a nocturnal insect, presumably a beetle, which flies against the eye and leaves its anterior horn embedded therein.

CHAPTER II

CHEMICAL INJURIES

THESE are of various kinds. (*A*) We shall deal first with the instances in which **the irritant material is furnished by small animals which actually find their way into the conjunctival sac;** but in doing so, we shall leave for consideration, in the next section, the subject of the deposition of dipterous and other larvæ on the eye or in its neighbourhood, for ocular myiasis, thelaziasis, etc., are true instances of parasitism, and will be discussed under that heading. What concerns us for the moment, is the accidental introduction into the eye of chemically irritating matter, accompanied by the presence of the animal which gives rise to the trouble.

One of the worst of these involuntary guests of the conjunctival sac is the *green bug* (of the family Jassidæ — popularly known as leaf-hoppers), which, as has already been mentioned, swarms after a shower of rain in Eastern countries, and which, whilst buzzing in the trees, fills the air with the well-known and offensive odour of its kind. If one of these insects happens to enter the eye, it at once resents its imprisonment by emitting a gush of its characteristic, foul-smelling, and violently irritating secretion into the conjunctival sac of its unwilling host. The author can testify from personal experience to the agonising pain thus inflicted, though all the victims do not appear to suffer alike. Colonel Drake-Brockman, formerly of the Madras Eye Hospital, used to tell the story of a guest he sat next to at an Indian dinner-party, who complained that every article of the menu, from the soup to the cheese, and from the sherry to the liqueurs, tasted of green bug; next morning, Drake-Brockman

removed from the grumbler's superior fornix a macerated specimen of the green bug.

Alcock states that minute insects, known as Thrips (of the order Thysanoptera), usually found in plants, and most frequently in their flowers, are apt to get into the eyes in India. They are active, squirming, little creatures, with narrow plumose wings. They cause excruciating pain, which lasts long after the little beasts are removed. The same authority is responsible for the statement that the acrid secretions of the "Stick-insects" (*Phasmidæ*) and of the locusts (*Locustidæ*) are reputed to be highly injurious if they get into the eyes.

Ruata states that the Spanish fly (*Cantharis vesicatoria*) and the cochineal insect (*Coccus cacti*) are responsible in tropical America for attacks of blepharo-conjunctivitis. These, again, are but local illustrations of many similar happenings in tropical countries.

We have next to consider the irritation and inflammation which may be caused by the accidental introduction into the eye of hairs or other structures shed by insects. It is true that some part, at least, of the trouble is mechanical, but it would be arbitrary and artificial not to consider the whole subject at this stage of our argument.

(*B*) **Irritation caused by Hairs or other Structures shed by Insects.**—Such cases are met with in a variety of forms. Amongst them is to be included a number of affections which we shall discuss in turn :

(i.) *Ophthalmia nodosa*, a disease caused by the presence of caterpillar-hairs which have lodged in the conjunctiva or cornea, or have made their way into the iris or choroid. A number of different species may furnish the offending hairs. A nodular inflammation results, which is apt to be mistaken for a tuberculous infection. Though met with in the Tropics, these cases are by no means peculiar to those regions. Indeed, the literature of the subject would not lead one to think them even especially common there; but, considering the very abundant insect life of hot countries, it is not improbable that the present deficiency of tropical records of such

affections will be made up for, as ophthalmic relief extends to lands which have hitherto lacked an efficient medical service. Excellent descriptions of ophthalmia nodosa may be found in the ordinary textbooks of ophthalmology, and especially in Parsons' and de Schweinitz' works. The latter states that a somewhat similar disease, clinically resembling trachoma, has been described by Markus, as the result of implantation of plant hairs on the eye. A field for research is opened up to the tropical practitioner. The author would again remind him that we see what we have been trained to look for, and we often miss very obvious phenomena, for which our minds are unprepared.

(ii.) *The Yellow Moth.*—Sakaguchi has given a very interesting account of the invasion of the city of Yamagata, by what is there known as "the yellow moth." The symptoms produced in man were mainly confined to the eyes, and consisted of redness of the lids and congestion of the conjunctiva. It was shown that the insects scattered abroad a powder, which contained an irritating acid of unknown composition, secreted by the cutaneous glands. This chemical action was reinforced by the mechanical irritation caused by the powder.

(iii.) *Fumuski Blennorrhœa.*—It seems likely that this affection has affinities with that caused by the yellow moth. For our knowledge on the subject, we are indebted to another Japanese writer, Takashima, of Saga, who states that his compatriots attribute many cases of conjunctival blennorrhœa and blindness to an insect (*Scoiinophora vermiculata*) which is known in Japan as the "kuro-kusakame" or popularly as the "fu" or "fumuski." During the summer the insects are very abundant at the time of the rice harvest. They fly into the houses and gather round the lamps, and the people are in the habit of catching them with their fingers. Takashima reports four cases of redness and swelling of the lids and conjunctiva attributed to the "fumuski." In three of these, the insect had flown into the eye of the patient, while the fourth patient had rubbed the eye with his fingers after handling one of the insects. In each case the symptoms subsided

in the course of a few days. The author experimented on animals, instilling into their eyes either the juice expressed from the tissues of the insects, or alcoholic extracts of their bodies. In yet other cases he rubbed the conjunctivæ of rabbits with the bodies of the insects. In all the experiments the result was the same — an affection of the eyes being produced, which closely resembled that contracted in the ordinary way from the insects. The chief symptoms were: Œdema of the lids and conjunctiva, attended with hyperæmia, muco-purulent discharge, and lachrymation. Takashima was fortunately unable to support the popular belief, that this form of blennorrhœa ever ends in blindness.

(*C*) **The Transference into the Conjunctival Sac, by Insect Agency, of various Extraneous Irritating Materials.**—Ruata is responsible for the statement, that in Cuba there is a fly which lives upon a poisonous plant, the *Euphorbia ferox*, and which carries the pollen of this plant to the lids of sleeping people, thereby setting up a severe vesicular eruption. He adds that this insect is protected from observation by its power of mimicking the colour of the foliage it makes its home.

We shall see immediately that insects are known to be carriers of other (septic) forms of poisonous matter for whose creation they are in no other way responsible; there is nothing, therefore, in the least improbable in this story, and it is quite within the bounds of easy belief that many such instances occur in various parts of the world where both insect and vegetable life are very abundant. We have already (p. 126) referred to Markus' observations on the results of the implantation of vegetable hairs on the eye. It is of interest to record that the hairs of the pods of *Abrus precatorius* cause the most intense irritation, if accidentally introduced into the eyes (A. Alcock).

The whole subject is one which should interest the tropical practitioner, and its study may throw light on some hitherto ill-understood forms of lid and conjunctival troubles.

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CHAPTER III

SEPTIC INFECTION DUE TO INSECT AGENCY

This subject has already been discussed at some length, when we were speaking of the causation and spread of epidemics of ophthalmia in the East (Sect. III., Chap. III.), and so requires little more than a passing mention now. The most dangerous carriers are probably the common house-flies ; but at certain times of the year, and in certain places, the eye-flies are for the time being still worse offenders. This is undoubtedly true of the hot weather in the plains of the Deccan and of many other districts with similar climates. The obvious practical lesson is that the breeding grounds of these dangerous pests should be destroyed ; in other words, the neighbourhood of human habitations in the East should be sedulously watched, and all collections of damp filth, and indeed of dampness or filth of any kind, should be dealt with promptly and efficiently. This is a large subject, and one that goes much wider than the domain of ophthalmology.

PART III

CHEMICAL INJURIES BY OTHER ANIMALS

INTRODUCTORY

There are certain poisons, known to affect the eye, which emanate from animals very different from the Arthropods, which we have been discussing, and yet the conditions produced show closer affinities with those which we have dealt with in Part II. than with those in any other division of our subject. It has therefore been decided, after very careful consideration, and "without prejudice," to deal with these matters here and now.

CHAPTER I

ASCARIS POISONING

Those who have occasion to handle specimens of *Ascaris lumbricoides*, as, for example, butchers, zoologists, and those medical men who conduct post-mortems, are liable to suffer from a form of conjunctivitis, owing to the body fluids of the parasites gaining access to the conjunctival sac. There is a remarkable difference in the susceptibility of various persons to this poison, some being immune, and others exhibiting an extreme idiosyncrasy. In the mild form, said to be produced by some effluvium given off by the worms, there is a subacute catarrh of short duration. If the body fluid of the worm comes into actual contact with the conjunctiva of a susceptible person, there is a sudden development of severe, burning lachrymation with pronounced chemosis. The lids become œdematous and the aperture of the eye is closed thereby. Dorff, who experimented on the subject, thought that the poison acted directly on the vessel walls, or on the sympathetic nerve endings in them. He considered it to be a soluble alkaloid. The subject is of interest to tropical practitioners, owing to the extreme frequency with which worms of this species are encountered amongst backward peoples.

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CHAPTER II

EEL'S BLOOD CONJUNCTIVITIS

Takashima, of Japan, has described a form of conjunctivitis, which is sometimes seen in fishermen after accidental contact of the eye with the blood of the eel. In a series of experiments on animals, he found that the simple instillation of the blood, or of the blood serum of the eel, gives rise to a moderate hyperæmia, associated with chemosis of short duration. A much more severe reaction was produced when the blood was injected subcutaneously, or when it was introduced into an eye whose conjunctiva had previously been injured. He described the changes found under microscopic examination. He believed the responsible toxin to be contained in the protein constituent of the serum.

Oblath has made observations similar to those of Takashima. He has observed a case of conjunctivitis following the direct action of the blood and bile of an eel. He has found by experiment that eel's serum produces complete hæmolysis, and that its effect is so powerful as to be perceptible even in a dilution of 1–640. The one respect in which Oblath's experience differed from Takashima's was, that the duration of the case was much longer—about six weeks.

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PART IV

STINGS AND BITES BY INSECTS AND OTHER ANIMALS

CHAPTER I

WASP AND BEE STINGS

It is, of course, an accident when the stings of these insects are inflicted on the eye or on the lids, but it is an accident which derives no small a measure of importance from the fact, that the symptoms are then sometimes out of all proportion to those which characterise such injuries of other parts. Moreover, the probability of meeting with wasp and bee stings is much greater in lands where these insects flourish in large numbers, and through a great part of the year, and where, as already pointed out, they habitually make their homes in, and in the neighbourhood of, human habitations. For any accurate records of such cases we must, however, turn to Western literature.

Several cases are on record in which a bee or wasp sting of the upper lid has led to injury to the eye itself. The sequence of events is supposed to be as follows : The pain inflicted induces a violent orbicular contraction, which breaks the sting off short, and then leaves it to work its way through the lid, and so to damage the conjunctiva or cornea, or both (Hilbert, Kraupa, Orendorff, and Purtscher). On the other hand, the sting may be inflicted directly on the surface of the eye, and may even penetrate the cornea or sclera (Baer, Hunald).

It has been stated that the bee is much more likely to leave its sting behind than the wasp is, because it is

recurved, whilst the latter insect's weapon is straight ; but in the event of a sudden violent contraction of the orbicularis muscle, it may be presumed that any form of sting might easily be broken off short.

In addition to the symptoms which one would expect to find present, such as œdema and discoloration of the lids, injection and chemosis of the conjunctiva, ulceration of the cornea and severe pain, yet others have been recorded : (1) The cornea may be very extensively deprived of its protective epithelium, and may also undergo wide opacification. (2) Well-marked iritis or irido-cyclitis may be present, attended by ciliary redness, hypopyon and keratitis punctata ; discoloration of the iris and meiosis are also in evidence. (3) Cataract may follow the sting, either as a result of the toxins introduced, or in consequence of a direct penetrating injury sustained by the lens (Baer). In Baer's case the cataract matured, and was extracted with good results. (4) Severe constitutional symptoms may be present.

Hunald experimented on rabbits, and found that the bee sting was often broken off in the cornea, and that corneal folds were seen radiating from the wound ; hypopyon and a curious affection resembling anterior polar cataract were observed ; it is of interest to note that perforation of the capsule was not essential for the production of the opacity ; at least, that was Hunald's opinion. He thought that the poison caused an active degeneration of the capsular epithelium, and that in consequence fluid was able to enter the lens.

It remains to add that a case of optic neuritis is on record as following the poisoned sting of an unknown insect (Guichemerre and Rochon-Duvigneaud) ; but we must rather regard this as of the nature of an accident, following the introduction of septic matter into the general circulation.

In conducting the *treatment* of these cases on ordinary lines we should not forget to make a very careful search, in every case, for the sting in the lid and in the eye itself. In the former situation, its presence is often indicated by

the presence of a hard inflamed lump. The prognosis, in most cases, would appear to be good; but, where the eye has previously undergone an operation, especially if it is one attended with the formation of a filtering cicatrix, there is reason to believe that the risk of serious uveal inflammation is considerably enhanced (Butler).

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CHAPTER II

MOSQUITO BITES

As a general rule, it is only the new-comer to the Tropics who suffers severely from mosquito bite, and it is especially the more exposed and thin-skinned parts of the body, that show the most marked evidence of the attacks of these insects. Thus, the thin skin of his ankles and wrists will be found covered with inflamed bites, and, for the same reason, his eyelids are very vulnerable. Now any inflamed sore on a part whose skin covering is thin, and whose connective tissue is loose in texture, is apt to lead to great swelling. This explains the complete closure of one or both eyes, which is not at all infrequently seen in the Tropics as the result of poisoned bites, whether by mosquitoes, spiders, ants, or other venomous arthropods. The condition is spoken of in some parts of the world as "bung-eye." If the lids are forcibly opened, it will often be found that the ocular conjunctiva shares in the œdema, even giving rise to a marked chemosis. The patients are often extremely alarmed, being under the impression that they have lost their sight, whereas the eye is really quite unaffected, and the symptoms subside with great rapidity, especially if hot fomentations are used. If the insect which inflicts the bite has settled shortly beforehand on some septic surface, the signs produced are all the more alarming, and may then be seen, not only in old European residents, but even, and by no means infrequently, in the natives of the district.

CHAPTER III

ANT BITES

Ruata states that the *Termes bucephalus* of Porto Rico is accused of attacking the eyes of sleeping infants, unless the cradles are safely hung. He also states that the great ant of Senegal, *Termes fatalis*, is reputed to give rise to a violent conjunctivitis by means of the acrid secretion which it pours out.

In India and in many other tropical countries, as has already been pointed out, ants are met with in very large numbers, and in a great variety of form, size, etc. The large black ants, though they look so formidable, very seldom attack the eye or its neighbourhood; when they do so, it is due to the accident of their being interfered with when running across the part, especially during sleep. The little red ants are much more inclined to give trouble; their bites are poisonous, and, especially when a number of the insects attack the lids in concert, may give rise to great swelling, attended by considerable pain. The tiny insects may be found hidden in the folds of the skin, and sometimes also in those of the conjunctiva. In the latter situation they give rise to a good deal of irritation and discomfort. They are extremely hard to detach, once they have laid hold, and the efforts of the patient or his friends to dislodge them not infrequently result in the pulling away of the body, whilst the head is left partially buried in the tissues, from which it in time sloughs out. When it is found within the conjunctival sac, it can be painlessly removed under local anæsthesia, breaking it up, if necessary, for the purpose. Neglected children and dirty people are much more apt to suffer from ant bites than the rest of the population. The habit many natives have of sleeping on the floors obviously renders them more liable to attacks by insects of all kinds than those, who sleep on beds or on any structures raised above the floor level.

CHAPTER IV

TICK BITES

The ticks belong to the Family Ixodidæ, Order Acarina, Class Arachnida, Phylum Arthropoda.

Though man is not their natural prey, both the hard and soft ticks will readily leave their normal animal hosts to attack him. The soft and thin skin of the eyelids furnishes a tempting surface for these blood-sucking animals, though there is no reason to believe that they especially attack this region. When they do so, it is more or less an accident, but one which is favoured, as already suggested, by the thinness of the skin covering the parts. Great swelling is sometimes caused by the bite, and the distended cutaneous folds have to be separated to find the tick, even though it may be bloated with blood. It has been suggested that the bite of certain of these insects is actively poisonous. Sometimes the animal will find its way into the conjunctival sac and take its feed of blood from the lining membrane of the eye. In whatsoever situation it is found, the tick is hard to dislodge, and if forcibly pulled away it leaves its head and feet behind it. These may give rise to festering sores, or may even be the cause of the formation of a conjunctival cyst (Cosmettatos). The insect should be carefully removed under cocaine anæsthesia. According to Ward, a tick will at once let go its hold if a drop of oil is applied to its surface.

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CHAPTER V

INJURIES BY OTHER POISONOUS ARTHROPODS

We have more than once mentioned the cases of swollen lids ("bung-eye") met with in the Tropics. There can be no doubt that a certain number of these, are caused by a variety of venomous arthropods other than those, which we have already described. The list of these pests is a long one, and varies according to the part of the world concerned. We must include in it the poisonous spiders, scorpions, centipedes, cantharides insects, and many others. The Indian native ascribes the long red weals which are sometimes seen on the eyelids or face to the urine of lizards, but this may probably be dismissed as a myth. It is more likely that they are caused by centipedes, by various beetles, or by caterpillars, which, while crossing the face, are disturbed by some movement of the patient, and resent the interference by digging in their claws in the case of the centipedes, by using their blistering powers in the case of the flies, or by leaving spines or hairs behind in the case of the caterpillars. Every tropical land has some form or forms of insects, credited with causing these weals. The exact species differ largely in different parts. In India, the beetles responsible are the Blister-beetles (*Cantharidæ*) and the Devil's Coach-horse beetles (*Staphylinidæ*). The caterpillars are those of the Tussore-silk moths (*Saturniidæ*), of the Eggar-moths and Lappet-moths (*Lasiocamphidæ*), of the Tussock-moths (*Lymantridæ*), and the Slug-caterpillars (*Limacodidæ*).

CHAPTER VI

LEECH BITES

In those parts of tropical countries, in which heat and excessive moisture give rise to a very luxuriant vegetation, as, for instance, in the neighbourhood of rivers, and especially of waterfalls, whose spray drives far and wide, animal life is found in luxurious abundance, and not the least plentiful of the fauna present are those belonging to the family of leeches. Many of these are very small, and it is necessary to have personal experience of them to realise how all-pervading they are ; indeed, they combine the ferocity of a tiger with the penetrating powers of dust ; they will worm their way even through puttees, or through any chinks in boots, and they will not hesitate to attack the eyelids and face, and even the conjunctival sac, if they can gain access to these parts. Fortunately, as a rule they drop off as soon as they have drunk their fill, and in any case they can be easily detached by the use of weak solutions of salt. Kuwahara reports from Japan two cases in which he found living leeches, apparently resident in the conjunctival sac ; one was in a youth of 18, in whom a black leech, 2·7 cc. in length, was found attached to the upper cul-de-sac of the conjunctiva near the outer canthus. The second patient was a girl of 10, with photophobia, lachrymation, and pain in the eye ; the conjunctiva was inflamed and scarred, and a leech 2 cc. in length was attached to the lower fornix. That even a large leech will attack the eye if the opportunity offers, is shown by the case reported by Coburn, in which a Russian Jew applied a leech to his eye in order to cause injuries, whereby he might avoid military duty. The result was the formation of a dense

crater-shaped leucoma, which involved the whole of the cornea with the exception of its outer portion.

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CHAPTER VII

MISCELLANEOUS

There are a number of injuries to the eyes which are somewhat difficult of classification. The author saw a young Eurasian woman in Madras who was lolling on the floor, when one of the hens, walking about the house, gave her a severe peck on "the white of the eye," causing a wound of the conjunctiva. He has also seen similar injuries from attacks by rats. Indeed, many animals will be attracted by the glitter of the eye, if the subject brings it within their reach. Such accidents are predisposed to in countries where the natives lie about on the floors instead of using beds or sofas. Apart altogether from deliberate attacks, some of the eye-injuries met with are due to animals, especially rodents, accidentally falling from the rafters on to the patient's face at night.

There is in India a large boring beetle, which nests by excavating the beams of houses, and which flies about with great force and with equal stupidity. It may inflict severe injury, if it happens to strike the globe in its flight. The same is true of the smaller bats, and of numerous other nocturnal animals. It is to be remembered that the natives of tropical countries go about a great deal without lights at night. They are probably saved from many injuries by night-flying animals, owing to their habit of singing chants "to keep the devils away."

There is a widely prevalent belief in the East that certain varieties of tree-snakes wait for passing men or animals, and strike at their eyes. The *Dryophis mycterizans* is specially suspect in this particular, on account of his pointed snout, which is generally believed by Indians to be a lance-like weapon of offence. As a matter of fact, this snout is

composed of soft scales, and could not do any damage. Apart altogether from this, the author is convinced, from a large number of experiments which he made with this and with other varieties of tree-snakes, that these animals show no preference whatever for attacking the eyes of animals.

Eye Symptoms in Snake-Bite.—In patients suffering from severe poisoning after the bites of colubrine snakes (the cobra, the karait, and the sea-snakes), a *paralytic ptosis* is a marked and very prominent sign. The writer first observed this when experimenting on frogs with cobra venom. He found that the lower lid invariably rose, thus tending to close the eye, and that the extent of this rise was a distinct indication of the intensity of the poisoning. A similar symptom, but of course affecting the upper lid, was noticed in lizards, in fowls, and in many other vertebrates, and was especially marked in monkeys. A poisoned monkey would throw back its head to obtain sight through the narrow palpebral slit left by the increasing ptosis; the position thus assumed was a characteristic one. Dr. F. H. A. Marshall, of Edinburgh, who was consulted on the subject, pointed out that the lower lid of the frog is depressed by a muscular effort, and raised again by an elastic rebound on the cessation of such effort. It is clear that the paralytic action of cobra venom on the eyelids affects in a similar manner both cold- and warm-blooded vertebrates. It is of interest to note that no such symptom is observed when an animal is dying from viperine poisoning, *e.g.*, by the bite of the Russell's Viper (*Daboia elegans*); indeed, it is easy to pick out animals poisoned by colubrine and viperine venom from each other by attention to this symptom alone. In countries such as India, where there is reason to believe that snake poison is not infrequently used, in order to get rid of superfluous relatives and of other persons considered undesirable, the value of this information is obvious.

It is well known that the poison of viperine snakes acts in an entirely different manner from that of the colubrine. When large doses are injected, there is a strong tendency

to *hæmorrhages* and to widespread *clotting of the blood* throughout the system. Such phenomena may, therefore, be looked for in the retinal circulation at an early stage.

It is stated that *hæmorrhages from the mucous membranes*, inclusive of the conjunctiva, are common in viperine poisoning. The author cannot remember having ever seen bleeding from the conjunctiva in animals poisoned by Daboia or Echis venom in India, and he had a very large experience with both these venoms.

Dilatation and fixity of the pupils is said to be constantly met with in viperine poisoning; this is in accordance with the author's experience in animals, and is in striking contrast with the absence of interference with the pupillary reactions in cobra poisoning.

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PART V

THE INVASION OF THE LIDS AND EYES BY SMALL ARTHROPODS

According to Raehlmann, the disease, blepharitis acaria, is caused by the activities of *Demodex folliculorum*, which belongs to the Family Demodicidæ, of the Order Acarina, Class Arachnida, Phylum Arthropoda. Oyenard, as a result of the examination of a large number of cases in the Spanish American islands, found that the parasite was very common in quite normal lids. He concluded that it is not really a pathogenic factor, but he thought it possible that it might have some unfavourable action on the parts, since it provokes dilatation of the mouths of the hair follicles, and thus lays them open to invasion by secretion carrying various micro-organisms. On the other hand, he found that the demodex was comparatively rare in cases under treatment for eyelid troubles, since it is readily destroyed by means of the commonly used antiseptic lotions and ointments. The one point that Oyenard made out clearly was, that this parasite becomes increasingly common as age advances.

Ruata says that in San Domingo there are small sarcoptera, about the size of an itch-mite, which invade the free edge of the eyelid. They presumably belong to the same Order as *Demodex folliculorum*, which has been spoken of above.

He also states that in Sierra Leone the eyelids of the negroes are specially liable to attack by the pubic louse (*Pediculus pubis*, Order Hemiptera, Class Insecta, Phylum Arthropoda).

The sand flea or chigger (*Sarcopsylla penetrans*) sometimes, though rarely, attacks the human eyelid. It is said to be very partial to the eyelids of parrots.

According to Ward, there are certain crustaceans, known as fish-lice, of the Order Copepoda, Fam. Caligadæ, which may be found in the human conjunctival sac, to

which they have been accidentally transferred, owing to the patient wiping his eye after handling fish, on the surface of whose bodies these arthropods are parasitic. Such invaders may be mistaken for cysts; they can be easily and gently removed, cocaine instillations being used to facilitate the procedure.

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SECTION V

PARASITIC DISEASES OF THE EYE

INTRODUCTORY

PART I.—PLATYHELMINTHES

CHAPTER I. TREMATODES.

„ II. CESTODES.

The Better-known Tape-worms.

Sparganum mansoni.

PART II.—NEMATHELMINTHES

CHAPTER I. FILARIA BANCROFTI.

.. II. LOA LOA.

.. III. FILARIA INERMIS.

.. IV. FILARIA OCULI HUMANI.

.. V. ONCHOCERCIASIS.

.. VI. THELAZIASIS.

.. VII. ANKYLOSTOMIASIS.

PART III.—ARTHROPODA

CHAPTER I. INTRODUCTORY.

„ II. OCULAR MYIASIS.

PART IV.—MISCELLANEOUS

CHAPTER I. RHINOSPORIDIUM KINEALYI.

„ II. MYCETOMA.

„ III. ASPERGILLOSIS.

„ IV. MURMEKIASMOSIS AMPHILAPHES.

INTRODUCTORY

It is a truism that no disease can be said to be really understood, until its cause is thoroughly well known. The statement applies with fully as much force to the parasitic ailments, as to those which are due to bacteria.

The discovery of a causative organism and the unravelling of the complications of its life-history, have revolutionised our conceptions, and straightened out the path of therapy, in every case in which such knowledge has been forced, by the toil of scientific investigators, from the close-shut storehouse of Nature's secrets. It is not merely that we add to the interest of the subject by mastering its theory; we do much more, for every triumph of the investigator pours a flood of light on the hitherto dark paths of diagnosis and treatment, and proves once again that it is impossible to value rightly the fruits of what may, at first sight, appear to be abstract and unremunerative knowledge.

This is as true of diseases, which have been known and studied for thousands of years, such as malaria and tuberculosis, as it is of trypanosomiasis, of undulant fever, or of blastomycosis. "Even from the standpoint of the practising physician, the exact description of the cause of a disease will outweigh in value the most elaborate clinical reports of refinements of diagnosis" (Jackson).

There is no branch of our study to which the above remarks apply with more force than they do to that of the diseases caused by parasites. Any one who takes the trouble to study at first hand the published reports of morbid conditions of the eye, which result from this form of invasion, is bound to be impressed by the fragmentary, unsatisfactory, and misleading descriptions of the causative organisms. Insect-maggots and nematodes of all kinds are spoken of as "worms," regardless of the fact that the zoological gap between them is a very wide one, and that it

would be fatal to clear thinking to thus confuse either of them with the annulata, which latter constitute a distinct, and much higher, phylum of the animal kingdom.

The reason of all this is not far to seek. A large number of medical men have but the haziest notions of zoology, and even among the better-informed there must be comparatively few, who are capable of classifying the human parasites they meet with any approach to accuracy.

In no branch is the difficulty greater than it is in the study of filarial disease. There are a large number of reported cases in which the descriptions are incomplete, or in which it is suggested that the immaturity of the organisms makes it impossible to determine the species to which they belong, or even to decide of which sex they are. Ward has proposed to classify such under the title "Agamofilaria." This more than implies that the main difficulty of classification is the sexual immaturity of the parasitic forms examined, whereas, to the author's mind, the real trouble lies in the want of expert knowledge on the part of the practitioners, who have the opportunities of meeting with these interesting cases. If, on every occasion, the specimen was at once placed, as Ward has suggested, in alcohol (70 to 85 per cent.), to which 5 to 10 per cent. of glycerine has been added, and if it were then dispatched to a competent authority,[1] our knowledge would grow by leaps and bounds, and the number of "unclassifiable filariæ" would dwindle correspondingly. The same remarks apply with fully equal force to the insect-larvæ, with which the parasitic nematodes are often confused.

It is probable that not the least of the sources of our difficulties lies in the fact that human eyes are accidentally and infrequently infested by forms of filariæ and of maggots whose normal habitat, at some period of their growth, lies in the eyes or in some other structure of members of the lower animal kingdom. The number of species of filariæ which are already known to infest vertebrate and other animals is very large; this gives us some idea of the wide

[1] All such material will be welcomed if sent to the Laboratories of The London School of Tropical Medicine, Endsleigh Gardens, London, N.W. 1.

extent of field which our subject opens up. The ocular lesions, produced by the nematodes alone, constitute an almost virgin field of research. There is an urgent need for careful, clinical reports, combined with accurate, detailed descriptions of the parasites concerned, and with careful laboratory studies of the secretions and tissues of the infested hosts. The tropical practitioner of to-day has opportunities open to him which were undreamt of by men of the older generation. They looked down, as it were, into the depths of the ocean of disease, trying vainly to see what its troubled waters concealed ; whilst to him, the twentieth century representative of science, it is given to turn the searchlight of modern microscopic and cultural methods on to its unexplored floor, and thus to see where his predecessors only guessed, and to know where they merely wondered.

It is important that the student should understand certain elementary facts in connection with the zoological position of the great group of parasites, which we are about to discuss.

The invertebrate animals are divided into a number of groups or phyla, namely—(1) Protozoa ; (2) Parazoa ; (3) Cœlenterata ; (4) Platyhelminthes ; (5) Nemathelminthes ; (6) Trochelminthes ; (7) Molluscoida ; (8) Annulata ; (9) Arthropoda ; (10) the Mollusca.

The Platyhelminthes include the flukes and tape-worms ; the Nemathelminthes embrace a large number of internal parasites, inclusive of the Ascaridæ and the Filariidæ. They are quite distinct from the worms and leeches with which they are often confused, but which are grouped under the much higher phylum Annulata. Amongst the Arthropods the most important groups from our present point of view are the Insecta and the Arachnida. These will be dealt with in a suitable chapter.

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PART I

PLATYHELMINTHES

CHAPTER I

THE TREMATODES

DISTOMA RINGERI

SYNONYMS.—*Paragonimus ringeri*. Cobbold, 1880; *Distoma Pulmonale*. Baelz, 1883, etc.

THIS is known as the lung-fluke, and is found in Japan, Corea, Formosa, and some other parts of the East. It is really a parasite of the lungs, as its name implies, but is also found encysted in various organs, and amongst others in the lids and the orbit. The removal of the tumours by operation does not appear to present any difficulty. Ward, to whom we are indebted for the above information, believes that the ova of the Japanese blood-fluke, *Schistosoma japonicum*, may find their way into the iris and there produce emboli. He suggests that those, who practise in the regions where this parasite abounds, should be on the look-out for such complications.

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CHAPTER II

THE CESTODES

The Better-Known Tape-Worms.—The tape-worms, which are commonly met with in Europe, are by no means rare in tropical and subtropical countries, but obviously much depends on the habits of the people. One would not expect, for instance, to meet with *Cysticercus cellulosæ* in a population of vegetarians, or to encounter hydatid cysts with any frequency amongst those who do not keep sheep. On the other hand, in countries like the Argentine, hydatid disease forms one of the everyday occurrences of surgical practice, and ocular cysticercus is commonly seen there. This is easily accounted for by the occupations, and by the insanitary habits, of the people.

Cabaut estimated that, in that country, one in every 4714 eye patients were cases of echinococcus of the orbit; he found that though the cysts may develop in any part of that cavity, they generally lie in or about the muscular cone; he never met with them within the optic nerve or eyeball. There is much pain on the side affected; the proptosis varies according to the size and position of the cyst; choked disc is common; transillumination and X-ray photography are valuable; an exploratory puncture is advised; the Kronlein operation is rarely necessary.

Demaria, of Buenos Ayres, has emphasised much the same points. He claims to be the first to publish a case of intra-ocular echinococcus in the Argentine, which "is the more surprising when contrasted with the cysticercus, which is so commonly found within the eye. Yet both tænias live and migrate in the same way." Of the four cases previously reported from other countries, he believes only one record to be entirely reliable. He draws attention

to one important feature of his own case, namely, "the absence of a pericystic membrane, or of evidence of leucocytic infiltration; this he attributes to the lack of inflammation in the intra-ocular structures. He contrasts this with what so commonly occurs in cysticercus cases, where an intense irido-cyclitis is almost the rule. Is it not possible that this is associated with the early tendency of the cysticercus to die?

Manson states that "the broad tape-worm (*Dibothriocephalus latus*) is known to occur in Turkestan, in Japan (where the natives are in the habit of eating raw fish), in Madagascar, and among the natives on the shore of Lake 'Ngami, South Africa. Ichthyophagous habits are probably responsible for the occurrence of *Diplogonoporus grandis*, another large dibothriocephalid, found in a Japanese from the province of Higen." He gives a list of the other tape-worms which appear to favour warm climates, but believes that list to be far from exhaustive.

The obvious moral of all this work is that the tropical practitioner should be ever on the outlook for evidence of cestodal parasitism of the eye in those countries, where the necessary conditions are favourable, and that he should lose no opportunity of adding to our knowledge of the subject by publishing his notes very fully, and by obtaining expert assistance in the accurate zoological identification of every parasite of whose identity he has the least doubt.

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SPARGANUM MANSONI (Cobbold, 1883)

The literature of the rare disease due to this worm is extremely scanty, and we are indebted for the major part of it to Manson.

The parasite is believed to be the larval form of a cestode which belongs to the family Dibothriocephalidæ. It was first discovered by Sir Patrick, in 1882, in the body of a Chinaman. Yoshida reports that 55 cases have since been recorded. This investigator found these worms in a cat, and fed a dog with them. Two months later, the latter animal passed a new species of tape-worm, *Bothriocephalus liguloides*, which he believes to be the parent form of *Sparganum mansoni* (Fig. 13). An instance of human infestation is recorded by Cleland from Australia, in which the worm, 10 cm. in length, was passed by the urethra, and produced strangury and haematuria at the time. In his article, he mentions two other Australian cases.

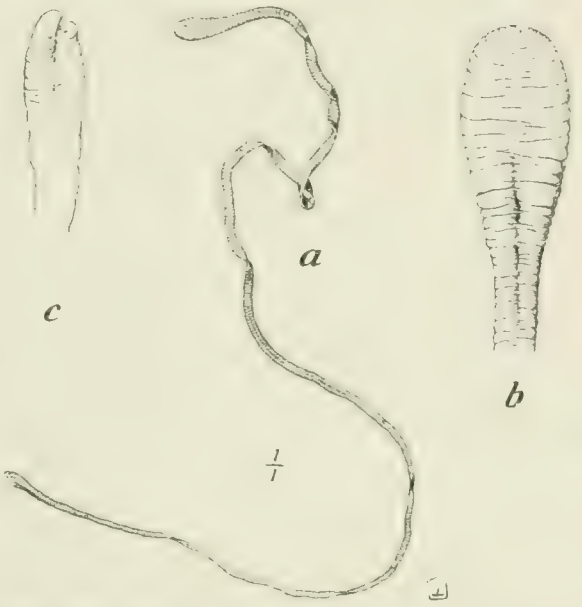

Fig. 13.—*Sparganum*. *a*, Natural size; *b*, anterior extremity; *c*, posterior extremity. Extracted from an abscess in a Masai. (After Sambon.) ex *Manson's Tropical Diseases*.

The larval form has been thrice found in Japan, lying beneath the conjunctiva and producing swellings the size of a bean.

"Casaux and others have called attention to the marked frequency, in and about the Tonkin delta, of the condition they designate ocular sparganosis. Pain, redness, and œdema of the upper eyelid, with lachrymation and ptosis, lead to an examination, and to the discovery of an almond-sized, indurated nodule. Incision of this reveals a small, yellowish, fatty mass, which, on section, is found to contain a coiled up *S. mansoni*. It is probable that in these cases similar parasites are present in other regions of the body" (Manson).

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PART II

NEMATHELMINTHES

This phylum is divided into three classes—(1) Nematoda, or Round-worms; (2) Acanthocephala, or Hook-headed Worms; and (3) Chætognatha, or Arrow-worms, a small group of pelagic organisms which do not concern us.

The Nematodes have been defined as follows (Shipley):—Animals with an elongated, unsegmented body, tapering at each end. A well-developed cuticle is secreted by the epidermis. A digestive system is present, and the excretory system takes the form of lateral ducts, which open anteriorly by a medium ventral pore. As a rule, they are diœcious, and many are endoparasitic; among the parasitic forms an alternation of hermaphroditic and bisexual generations may occur. A ciliated epithelium is universally absent.

The class Nematoda is divided into the orders—(1) Nematoidea; and (2) Nematomorpha.

The order Nematoidea is again divided into a number of families—(1) Ascaridæ; (2) Filariidæ; (3) Anguillullaidæ; and (4) Strongylidæ.

In a previous section we have dealt with the eye symptoms ascribed to *Ascaris lumbricoides* (Ascaridæ). We shall now take up the diseases of filarial origin (Filariidæ), and then pass on to consider *Ankylostomum duodenale* and *Necator americanus*, the two representatives of our fourth family (Strongylidæ).

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CHAPTER I

FILARIA BANCROFTI (Cobbold, 1877)

(Kindly contributed by Dr. P. Manson-Bahr)

This parasite is widely distributed, being found in India, China, and most parts of the Tropics. Where it occurs, its embryo, the *Microfilaria nocturna*, appears in the peripheral blood-stream, but only by night, hence its name (Plate V.).

In the Pacific Islands, and especially in Fiji, Samoa, and the Philippines, filariasis is rife, and indeed in some of the islands over 80 per cent. of the inhabitants show evidence of harbouring the parasites. The filarial worm found there is apparently identical with *F. bancrofti*: but the embryos, though otherwise indistinguishable from *Microfilaria nocturna*, differ from the latter in this respect, that they exhibit no definite periodicity, and are to be found in the peripheral circulation, in equal numbers, both by day and night.

The next point to bear in mind is that eye diseases of many kinds are rife among these islanders. It has been, perhaps, too lightly assumed that the filariasis is the cause of the ocular troubles. In dealing with a population so deeply infested as this is, it is obviously very difficult to decide whether any given pathologic condition, be it of the eye or of any other part, is really due to the activities of the parasites.

We shall first discuss the various eye conditions which have been ascribed to filariasis in the Pacific Islands. Leber has put forward the following:

1. *Inflammation of the upper lids* with œdematous swelling, accompanied by great itching.

PLATE V.

Microfilariæ of the blood.

1, Mf. bancrofti; 2, mf. perstans; 3, mf. loa; 4, mf. demarquaii.

2. *Pterygia.*—These have been included on the strength of this investigator's findings of the presence of microfilariæ in sections of such growths, removed from Samoans ; he also found fatty cysts embedded in the fibrous tissue of the parts.

3. *Retinal lesions.*—These consisted of hæmorrhages, with yellowish atrophic patches, which were ascribed to the results of arterial and venous obstruction by the microscopic organisms.

To this list Ziemann has added a fourth item :

4. *Elephantiasis of the upper lids*, met with in Central Africa and believed to be of filarial origin. Possibly this is a later stage of 1.

Lastly, we come to a contribution made in 1888 by Lewis.

5. *A granular condition of the lids*, which that writer believed to be due to the agency of *Filaria bancrofti* ; he was able to demonstrate the microfilariæ in the lachrymal secretion of his patients. He thought that the embryos made their escape through ruptures in the tissues.

The writer is unable to accept this list without grave reservations. In his experience pterygium is very commonly met with amongst these islanders, and especially in those who are engaged in maritime occupations, such as fishing and boating. That microfilariæ have been found in sections of this tissue is not to be wondered at, in view of the fact that these embryos are very commonly met with in the peripheral circulation of heavily infested individuals ; indeed they may be demonstrated in almost any tissue of the body.

With regard to the retinal lesions, it is to be remembered that Yaws is extremely prevalent in some of these islands, and it would therefore be hardly safe to leave it out of count as a possible causative agency.

During the attacks of filarial fever, there is a form commonly met with in heavily infested districts which is colloquially known in Fiji as *liliwa*, and in Samoa as *mumu*. This is accompanied by rigors and hyperperexia, and there

is a general suffusion of the conjunctivæ, closely resembling that which has been described in phlebotomus fever. It is suggested that this condition is due to toxins given off by the *Filaria bancrofti*.

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CHAPTER II

LOA LOA

Synonyms,—*Filaria oculi ; F. conjunctivæ ; F. diurna ; F. bourgi ; F. loa ; Dracunculus oculi.*

This parasite has been known for three centuries ; it appears to be widely distributed throughout tropical West Africa, from Sierra Leone to Benguela. In some parts, as in Old Calabar, the Cameroons, and the Ogowé River, a very large portion of the inhabitants are the host of this pest. So far as Europeans are concerned, Benin city seems to be the most important endemic centre. The worm has been carried to many parts of the world by its unwilling hosts, but it has always failed to spread, away from its own habitat ; thus, it travelled to South America and to the West Indies with the streams of negroes, but it died out in both places as soon as their deportation was stopped. It is seen from time to time in Great Britain, America, and other countries, in both white and coloured patients, but the subjects always hail from West Africa. This peculiarity of the disease suggested that the intermediate host of the parasite must be restricted to the area in which the latter flourishes. The fact that its embryos, the so-called mf. diurna, only appear in the blood by day, indicated that the blood-sucking fly was of diurnal and not of nocturnal habits. Manson came to the conclusion that the mangrove fly, *Chrysops dimidiata*, was to blame ; and Leiper, following up this hint, traced the development of the worm in the salivary glands of that insect. After entering its human host, the parasite matures slowly, for it usually fails to make its appearance under the skin or in the eye until several years after the patient's first entry

into the endemic area. The shortest period on record would seem to be that of a patient of the author's, who noticed the presence of the parasites in and about his eyes within a year of his arrival in Benin city. It has been stated that while the immature, active worm is often seen in children, the larval form in the blood is rarely found except in adults, suggesting that full sexual maturation of the para-

FIG. 14.—*Chrysops dimidiata* v.d. Wulp. ♀ × 8.

sites is a long-drawn affair. Once infection has been accomplished, the worms may make their appearance, from time to time, at irregular intervals, for very long, if not for indefinite periods; such recurrences have been known to occur for at least fifteen years, and it may well be that probably even this is not by any means the limit.

The Habits of the Fly.—*Chrysops dimidiata* (Fig. 14) is a diurnal blood-sucker, which draws large quantities of blood.

but inflicts little or no pain whilst doing so. The natives call it the *Osun*. It is of a yellow colour, and is said to settle on its victim in a very sly and unobtrusive manner ; in this it resembles the tsetse fly. Like the Indian mosquito, it bites largely around the ankles, which probably means

Fig. 15.—*Chrysops silacea* (Austen). ♀ × 7.

that like them it is partial to the shade furnished by tables, etc. As a rule, the bite leaves no after-effects, but like that of the mosquito, it at times may be poisoned. Residents in the endemic area are advised to protect their ankles and shins by wearing high boots and thick stockings. Fig. 15 shows *C. silacea*, a closely allied fly, which is also suspected of serving as a carrier for *Loa loa*.

The Worm.—Both sexes are found burrowing in the subcutaneous tissue of man. The female is the larger, and is usually from 30 to 40 mm. long, but worms of 60 and 70 mm. in length are on record. The male is generally shorter than the female; its length has been given by various authorities as between 16 and 34 mm.; but the specimen removed by the author scaled 36·5 mm. when fresh, whilst that extracted by Terrien and Prelat was approximately 50 mm. long. It would appear that the length of the worm is not primarily dependent on the time the infection has lasted. The *Filaria loa* (Figs. 16 to 20) is

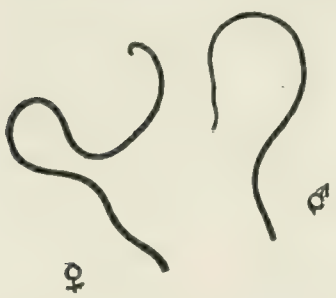

FIG. 16.—Loa loa. (Nat. size.) *ex* Manson's *Tropical Diseases.*

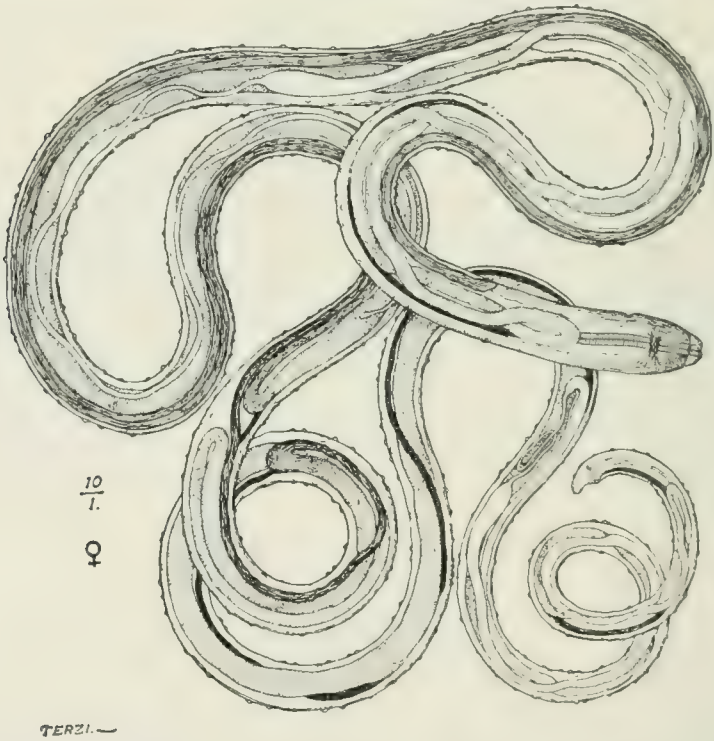

FIG. 17.— Loa loa, female. (Partly after Looss.) *ex* Manson's *Tropical Diseases.*

a white or yellowish worm resembling a piece of fine fishing gut or violin string. Its anterior extremity is blunt and rounded, whilst the posterior end is pointed, and in the male

is bent in a characteristic curve. The mouth is unarmed but somewhat protuberant, and the intestine is straight. In the female, the uterus can be readily recognised, as it is filled with ova, many of which contain embryos. The caudal end of the male is distinguished by possessing five papillæ on either side of the anus ; these are believed to be claspers, etc., for copulatory purposes ; also two short and uneven spicules protrude from the ano-genital orifice. A characteristic feature of the parasite is the presence of a number of round, smooth, hyaline, cuticular protuberances which project above the general surface, and which vary greatly in number, but are said to be more numerous in the female.

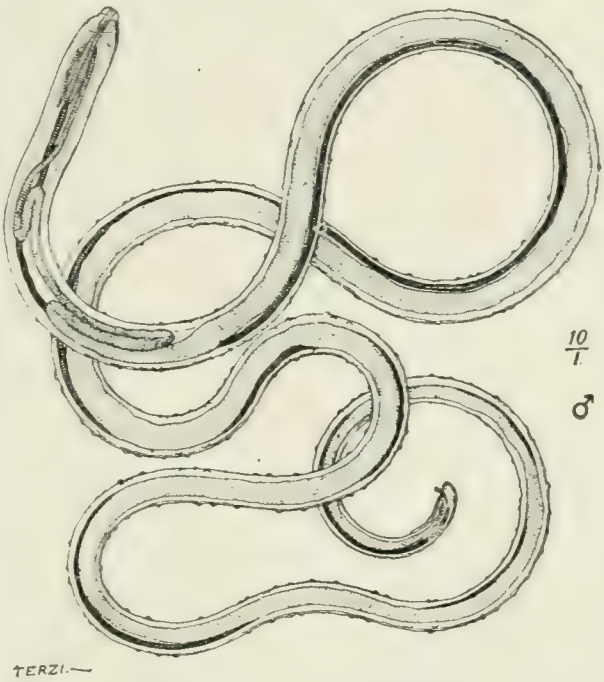

Fig. 18.—Loa loa, male. (Partly after Looss.) *ex* Manson's *Tropical Diseases.*

Fig. 19.—Posterior extremity of Loa loa, male. (After Looss.) *ex* Manson's *Tropical Diseases.*

Fig. 20.—Posterior extremity of Loa loa, female. (After Looss). *ex* Manson's *Tropical Diseases.*

Symptoms.— Usually, the first sign of loa infection is the presence of *Calabar swellings*. These come suddenly and disappear gradually ; they may occur in any part of the body. Each is about the size of half a

goose egg. They are hot to the touch, and also to the feel of the patients ; they are said to be usually painless, but may be extremely painful, at any rate when occurring in the hands ; under these circumstances there is bitter complaint of the tightness of the skin over them ; they are supposed to be due to the emission of embryos by a female worm ; they never suppurate.

The next trouble is the appearance of the parasites under the connective tissue, which may occur very soon after the Calabar swellings have first manifested themselves. The patient feels the worms moving about in various parts of his body, but they occasion him comparatively little inconvenience except when they invade the neighbourhood of the eye and ear. In the former situation, and especially at the inner canthus, they cause great irritation, which becomes intense when they find their way under the conjunctiva. The combination of itching, pain, and irritation caused by their movements is described as simply maddening. Almost instant relief is obtained when the parasite dives into the deeper tissues. The instillation of a solution of cocaine into the conjunctival sac appears to poison the worm, whose movements then cease, with the result that the patient obtains a respite from his suffering and can get to sleep. There is reason to believe that the loa can be killed in this way, and may then become encysted locally.

The observations on the ear symptoms, set up by *Loa loa*, are derived from the experiences of the author's case alone, though it is difficult to believe that they are not common to many others. This patient suffered, on a number of occasions, from an intense neuralgia behind, below, and in front of the ear ; this was accompanied by great hyperæsthesia of the superjacent skin. He described the attacks as being so definite that, by their aid, he was easily able to diagnose the arrival of a fresh worm, even before he became aware of its presence in the neighbourhood of the orbits. The pain would pass away with a dramatic suddenness, which he learnt to regard as characteristic of these attacks ; very shortly after this, he would feel the worm moving about in the neighbourhood of the orbit.

The visits of the worms to the surface occur with great irregularity, and it appears to be impossible to say what conditions bring them to the skin. In cold climates, it has been observed that the parasite is likely to come to the surface, in the face region, if the patient sits in front of a warm fire. The removal of one worm from an eye would appear to be not infrequently followed by a visit from a second parasite within a very short period, and often as soon as the next day. Two explanations of this phenomenon suggest themselves—(1) That the conditions, atmospheric or otherwise, which attract one worm to the surface, may equally readily attract two or more ; and (2) that the excursions of the parasites through the connective tissue of their host may be hymeneal in nature.

A good deal has been written on the rate at which *Loa loa* travels in the human body, and an estimate of an inch in two minutes has been made. Probably, however, much depends on the particular part they are invading ; certainly the rate of movement under the conjunctiva is very greatly in excess of this estimate ; indeed, the worms move so fast in this situation, that unless the surgeon is ready and resourceful, he may easily lose them. On not a few occasions, surgeons appear to have cut down on the worm and even to have exposed it in the wound, only to see it disappear under their very eyes, before they could seize it in the grasp of a pair of forceps ; nor is it only on the surface of the eye that they travel with such rapidity, for the movements of one of these pests may be clearly felt by the patient, as it travels from one side of the face to the other across the bridge of the nose, and this in the space of a very few minutes. It has been suggested that the worms make regular paths for themselves in the connective tissue ; indeed, it is claimed that such tracks have been definitely recognised. It is probable that, where such exist, the rate at which the parasite travels is very much greater than it otherwise would be.

The author has been informed, by a surgeon with large experience of *Loa loa*, that a peculiar difference exists between the movements of this parasite according

as it occurs in European or African patients. He has extracted a large number of the worms from natives' eyes, and has found the animals extremely sluggish: they make no attempt to escape, even when comparatively roughly handled, nor do they, in his experience, at any time show the rapidity of movement, which is characteristic, when the parasites inhabit Europeans.

A low form of fever may occur in these cases, and it is suggested that this is due to the reproductive efforts of the parasites.

The larval form of this parasite occurs freely in the blood of late cases of the affection. It was originally described by Manson as the *Microfilaria diurna*, owing to its habit of appearing in the daytime. His suggestion that it was the larval form of *Filaria loa* has been proved to be correct. Although we know how these larvæ are removed from an infected patient by the blood-sucking *Chrysops dimidiata*, no light has yet been thrown on the method of infection of their next victim.

Brunetière has described a case of suddenly developed right hemiplegia occurring in a *Loa loa* patient. He considered that the trouble was probably due to a blockage of the terminal branches of the left Sylvian artery, possibly by an adult filaria, but more probably by a mass of microfilariæ. The patient recovered, and so the explanation must remain unestablished.

Low and Petit have shown that in differential leucocyte counts, eosinophilia is the striking feature in blood examinations. In spite of the fact that it is very marked, it does not appear to influence the general health detrimentally in any way. Another point of interest, which we owe to both Manson and Low, is that there may be a complete absence of embryos in the blood of long-standing cases, even though the patient may present Calabar swellings, and may be the host of the adult worm.

Treatment. — This consists of the removal of the parasite whenever a favourable opportunity offers. The principal difficulty in so doing arises from the irregularity with which the worm visits the skin surface, and the rapidity

with which it leaves it when alarmed and disturbed. A patient may feel the animal in the neighbourhood of the eye and may hurry off to his surgeon, only to find that in the interval it has disappeared. Again, he may actually arrive with the worm under the conjunctiva or in the lids, and yet his haste may be fruitless, owing to the worm diving into the deep tissues as soon as the surgeon attempts to examine the parts. Everything that is required must be in readiness; the lid must be very gently pulled down or up, as the case may be. If the worm is seen, a 4 per cent. solution of cocaine, combined with adrenalin, should be carefully instilled. If the worm attempts to escape, it should be seized through the conjunctiva with fixation forceps, even if cocaine anæsthesia is still incomplete. The grip of the forceps should be maintained, while fresh cocaine and adrenalin drops are added until sensation is abolished. A silk suture should then be passed under the worm, and tied sufficiently tight to prevent its escape, whilst arrangements are being made for its methodical removal. The latter is effected by making a snip in the conjunctiva over the worm. As soon as this is done, the animal's lashing movements liberate one of its extremities, which then stands out from the wound swaying from side to side; this is at once seized with forceps and the worm gently withdrawn. If this cannot be done otherwise, the imprisoning suture should be cut through; but in the author's case this was not found necessary. The conjunctival wound is then closed, a suture being inserted if need be. Should the parasite disappear before it can be seized, it may be brought to the surface again by the aid of hot fomentations. Whilst these are being given, the instruments, suture, etc., required for the operation should be made ready, to avoid any delay once the worm is again sighted. If the parasite is under the skin of the lids, the same method as above described may be employed, but the technique is then obviously much simplified. Once the imprisoning suture is in place, a hypodermic of cocaine can be given, and the extraction proceeded with later, both deliberately and painlessly.

Dr. Manson-Bahr has suggested to the author that, in

view of the success which has attended the treatment of Bilharziasis with tartar emetic in cumulative doses, the same line of therapy should be carried out in *Loa loa* cases. He recommends a first dose of 0·50 gr., and then doses rising by from 0·50 to 2 gr. each time, given at one day intervals, until a maximum of 25 gr. is reached.

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CHAPTER III

FILARIA INERMIS

We are not yet in a position to formulate a clear statement of our knowledge of certain parasites, which have been found in the human eye. There is an interesting group of records of what would appear to have been filarial organisms, which were found under the conjunctiva, but which certainly differed from *Loa loa*. Unfortunately, the scantiness of the reports makes it quite impossible for us to classify these parasites, zoologically, with any approach to certainty. Some of them have been referred to the species *Filaria inermis*. If we clearly recognise that such an identification is scientifically unsatisfactory, and if we merely use the knowledge it connotes as a starting-point for further and more accurate study, we can do but little harm thereby.

The parasites, to which we refer, resemble *Loa loa* in the fact that their habitat would appear to be the cellular tissue of the body, and that, in the course of their wanderings, they, from time to time, invade the subconjunctival tissue and the lids. But in one important respect they differ markedly from *Loa loa*; for, whereas the latter is usually from 30 to 40 mm. long, and the largest specimens on record have not exceeded 60 or 70 mm. in length, the nematodes we are discussing have measured as much as 100 mm. or even more. Thus, Yarr mentions that one of these, which was removed from the conjunctiva, is to be seen in the Museum of the Ospedale Maggiore of Milan, and that it measured 115 mm. in length. Again, Angelo Pace, of Palermo, extracted from the human eyelid a filaria 100 mm. long by 1·5 mm. in breadth. Yarr places in the same group a worm, removed by Valadà, from under the bulbar conjunctiva of a woman of 60 (Blanchard). Forbes has

described the removal of a filaria from a cystic swelling near the inner canthus of a Serbian, in the Balkans, during the Great War. The specimen in question was a female; it was apparently immature, and measured 94 mm. in length by 0·5 mm. in breadth. No embryos were found in the patient's blood.

The interest of these observations to the tropical practitioner is so obvious that it does not require to be laboured. It is essential that he should realise that all parasites found under the conjunctiva are not necessarily nematodes, and also, that even those that are unquestionably filarial, must not be too lightly assumed to be specimens of *Loa loa*. The only way in which our knowledge can be advanced is by the reference of every such specimen to an expert under the most favourable possible conditions. As has already been pointed out, the parasite should be placed immediately on removal in 70 to 85 per cent. alcohol, to which 5 to 10 per cent. glycerine has been added. If this solution is not available at the moment, the specimen should be placed in normal saline solution while the other is being prepared. Should the practitioner not be in touch with any zoological expert, he will find a ready welcome for his material at the Laboratories of the London School of Tropical Medicine, Endsleigh Gardens, London, N.W. 1. The author makes no apology for repeating this information, because he considers its value justifies him in doing so.

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CHAPTER IV

FILARIA OCULI HUMANI

Filariæ have been met with in man in the aqueous humour, in the vitreous, in the lens, and beneath the retina, but the rarity of these occurrences is in striking contrast to the frequency with which similar parasites are encountered in horses, asses, and oxen in certain Eastern countries. Not a few of the human records leave much to be desired in the matter of the precision with which the zoological classification was conducted. The author is aware that the name, which he has chosen for the heading of this chapter, is a very indefinite one, and that it simply implies that the filaria occurs within the human eye, as contrasted with *Loa loa* or with other species, which have been found in the subconjunctival tissues or elsewhere in the neighbourhood of the globe.

Filaria in Animals.—The occurrence of free-swimming filariæ in the aqueous chambers of the horse and ox is well known to those who practise in India, Burma, and Ceylon ; it is comparatively infrequent in China, and is rare in S.E. Europe and in America ; the presence of the epizoa amongst oxen has been recorded in France and Belgium. Filariæ have also been observed in the eyes of camels and turkeys. Lingard has published a comprehensive paper on the subject, and Pridmore and Coats have added interesting details in connection with a case of their own. The symptoms in the horse are as follows :—Epiphora, photophobia, blepherospasm, iritis, turbidity of the aqueous, and diffuse keratitis. If the parasite is removed early, the eye may clear up, otherwise the prognosis is very bad. The worm can be seen swimming freely in the anterior chamber with very rapid lashing movements ; at times it disappears from

the anterior chamber, and passes behind the iris into the posterior division of the aqueous cavity. The extraction of the parasite is an easy matter. The horse is thrown, the eye is cocainised, a keratome incision is made at the periphery of the cornea on the outer side, avoiding the loss of any aqueous ; then a curette is taken in hand, and the surgeon waits until the filaria visits the neighbourhood of his incision; at the psychologic moment, the posterior lip of the keratome incision is sharply pressed backward, and the gush of fluid which follows carries the worm with it. Neumann and Lingard have described the parasite under the name of *Filaria equina* ; Abildg Lazan has identified it as *Setaria equina* ; others have recognised it as *F. papillosa*. This question and the anatomical description of the parasite are dealt with in Pridmore and Coats' communication, to which the reader is referred.

Dr. Manson-Bahr has kindly added the following further details : "The normal habitat of the worm is the peritoneal cavity of the horse, ass, or mule, and it is often found attached to the outer surface of the large gut. The embryo, *Microfilaria sanguinis equi*, recorded as occurring in the blood-stream of the infested animals, measures 0·28 mm. in length and 7 μ in breadth. The intermediary host is thought to be a mangrove fly, *Chrysops excutiens*. The male worm is from 6 to 8 cms. in length, and is 0·5 mm. thick ; it has a spirally-coiled sharp tail, which is provided with 6 papillæ, 3 pre-anal and 3 post-anal ; there are 2 short spicules. The female is twice as long as the male, and has a blunt posterior extremity."

Filaria in Man.—As we have already indicated, the parasite may be found in different parts of the eye ; we shall deal with these in turn.

The Aqueous Chamber.—The earliest case on record is stated by Parsons to be one which occurred in a negress of San Domingo, and which was reported by Mercier in 1771.

Barkan's case has been challenged. The patient was an Australian who had landed in San Francisco, where he came under observation. A whitish, thread-like, immobile

foreign body was removed by a downward iridectomy' together with the portion of iris to which it was adherent, and was stated by Knapp to be a specimen of *Filaria medinensis*, a diagnosis which throws grave doubt on the competency of the examination.

Lopez, in Havana, saw a parasite in the anterior chamber of a European woman, aged 61 ; there was slight keratitis and iritis. The animal was white, thread-like, and very active ; it measured 2·5 cm. in length, and passed from the anterior into the posterior division of the chamber, where it was killed by atropin ; as the patient refused operation, an exact classification was impossible.

Coppez' case was that of a negress, aged $2\frac{1}{2}$, who came from the Congo. The worm, which was 15·2 mm. long, died within the eye. Up to that time it had caused no inflammatory reaction, but immediately after its death iritis set in, and it had to be removed. It was described as being incompletely developed and without sex-differentiation.

The other cases reported are still more unsatisfactory (Macnamara and Drake-Brockman).

The Lens.—According to von Nordmann, filariæ are not uncommon in the lenses of the frog and the perch, but are very rare in man. In a lens sent him by von Graefe (1831), he found two dead filariæ, which were thread-like, were 2 mm. in length, and possessed a digestive tract. Gescheidt found three filariæ, varying in length from 1·5 to 4·5 mm. in a cataract sent him by Von Ammon of Dresden. Schöler, in 1875, showed the Medical Society of Berlin a living worm in a human lens. Virchow pronounced it a nematode ; it was 12 to 15 mm. long, and moved continuously.

The Vitreous.—Here, too, considerable doubt surrounds the observations on filariæ made by Quadri, Fano, Schöler, and Eversbusch. In some at least of these it seems likely that the persistence of a cord, representing the posterior part of the central hyaloid artery, may have been mistaken for a parasite. Fernandez on two occasions saw small filaria-like animals moving in the human vitreous, which

was hazy in consequence. In one case the parasite disappeared and the signs cleared up.

The Subretinal Space.—There would appear to be only one claim on record of a filaria having been discovered in this situation. The admirable résumé of this given by Yarr runs as follows : "A man, aged 31, presented himself with a complaint of defective vision in the right eye of two months' duration. On examining the fundus a whitish swelling, like a pin's head, could be seen in the macular region ; the rest of the eye was normal. Two months later, the swelling had increased to the size of the optic disc, and had a greyish spot in the centre, from which a mobile thread-like body protruded into the vitreous. Still later—nearly five months after patient was first seen—pain and photopsiæ were complained of ; and on examination, movements in the tumour itself could be detected. Kahut concluded he had to deal with a subretinal entozoon making its way into the vitreous, and he decided to attempt extraction. He divided the external rectus, rotated the eye forcibly inwards, and incised the eyeball at a point corresponding to the site of the tumour ; a gush of vitreous followed, carrying with it a little grey lump, which, on hasty examination with a lens, proved to be a rolled-up worm. The wound was sutured, the rectus reunited, and the patient did well, recovering a certain amount of peripheral vision. The drawing of the parasite, in Kahut's paper, shows a nematode worm, pointed at one end, blunt at the other, measuring 10 mm. by 0·3 mm. Rudolph Leuckart, who examined it, describes it as a larval filaria or strongylus, or possibly a scolex embryo."

The only comment that can be offered is that it would have been interesting, if the possibility that the parasite was a maggot, could have been excluded. In this connection the reader is referred to Part III. Chapter II., where he will find a reference to the cases in which the larvæ of the fly *Hypoderma bovis* had bored their way through the scleral envelope into the interior of the eye.

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CHAPTER V

ONCHOCERCIASIS

SYNONYMS,—*Onchocerca volvulus*. Railliet and Henry, 1910; *Filaria volvulus*, Leuckart, 1893.

Onchocerca volvulus is a filariform nematode, which occurs commonly amongst the negroes of the West Coast of Africa, and forms skin tumours which contain the worm, and which sometimes attain the size of a pigeon's egg. The presence of this parasite has not been associated with the occurrence of eye lesions by workers in tropical medicine; but, quite recently, Pacheco Luna, of Guatemala, has described a chronic form of punctate keratitis, which he unhesitatingly ascribes to the activities of the parasite we are considering, and which he has, therefore, named "keratitis punctata onchocercosa." He claims to be able to diagnose the presence of the filaria from an observation of the eye symptoms.

In the first, or acute stage, which develops within a few days, there is intense photophobia, accompanied by smarting pain, but without vascular injection. The corneal changes suggest to Luna's mind those described by Fuchs in 1889 as superficial punctate keratitis. The lesions run a chronic course, and may last for years, leaving permanent infiltrations of the cornea behind them. Vision is greatly reduced, and the skin swellings of onchocerciasis reveal themselves on examination.

In the next stage, the pain and photophobia have diminished, but a chronic fibrinous iritis sets in with a slow insidious course.

At a late stage many of the patients are blind; the punctate masses are aggregated in the lower half of the

cornea, and the pupil is occluded and drawn down to the neighbourhood of the corneal exudation ; it is irregular, greatly contracted and fixed, with its maximum diameter vertical. Operations on the iris, undertaken for the relief of the condition, would appear to be of little avail in many of the cases, owing to the concomitant presence of deep-seated changes. On the other hand, some brilliant successes are claimed as the result of the operative removal of the tumours containing the filariæ.

Luna believes that the signs and symptoms he has described are due to the secretion by the parasite of a toxic substance which is capable, under favourable circumstances, of exciting definite ocular lesions.

Dr. Manson-Bahr has favoured the author with his views on this subject. He points out that human onchocerciasis is not indigenous in the New World, but is thought to have been imported by negroes from West Africa. He lays stress on the fact that no descriptions have been given of the nematodes extracted by Luna from the tumours, and he suggests a doubt as to whether we have here to do with cause and effect.

Luna's communication is, however, of undoubted interest, and tropical practitioners should be on the look-out for such cases as he has described, and if they meet with such, should give them their very careful attention.

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CHAPTER VI

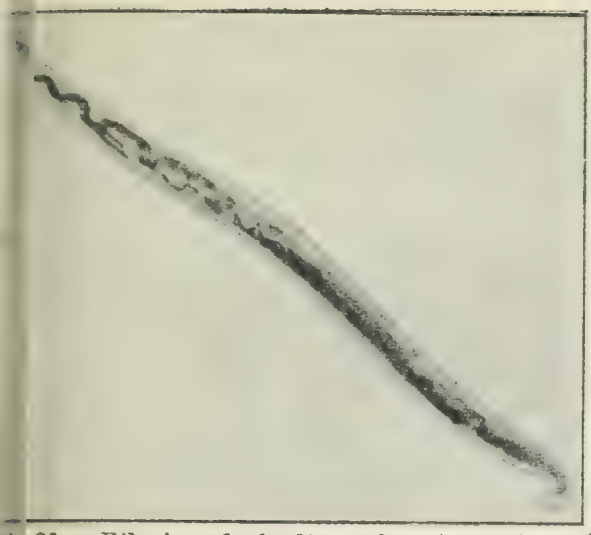
THELAZIASIS IN MAN

In the *China Medical Journal* of January 1917, Dr. E. J. Stuckey brought to notice a hitherto unknown affection of the human eye: A young man complained that for some time past he had worms in his right eye, and, in confirmation of his statement, he produced a small, white, thread-like object. After careful examination, an almost invisible body was seen moving in the upper fornix. Under cocaine "four white worms, like thread-worms, 8·13 mm. long, were removed from the fornices." The next day the patient removed still another worm (Figs. 21 to 25).

In the May issue of the same journal, Dr. C. J. Trimble described a similar case occurring in a Chinese farmer, who three months before had noticed pain in his right eye, which had become steadily worse until he was seen; it had been associated with epiphora and marked ectropion of the right eye, and a similar slighter condition in the left eye. The ectropion was due to a nearly complete, right-sided, facial paralysis, and was associated with a slight conjunctivitis. In the upper fornix of the right eye, Dr. Trimble discovered two small active, pink worms, the removal of which at once relieved the patient's pain. He was under observation for three weeks, during which time the epiphora disappeared, and the muscle tone in the paralysed area was largely restored. The facial paralysis was apparently due to the irritation caused by the parasite.

Similar worms were found in the eyes of a pet dog at Tungchow, and all the specimens were examined by Dr. Houghton, of Shanghai.

Zoological Position.—Leiper agrees with Dr. Houghton that the parasites are related to the eye-worms found



21.—*Filaria palpebralis*, male. (× 12.)

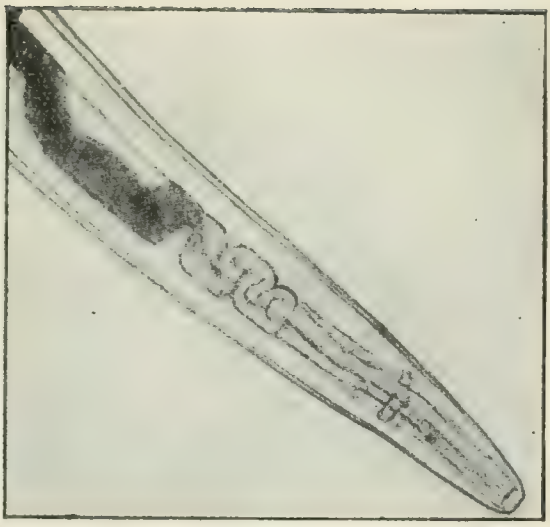
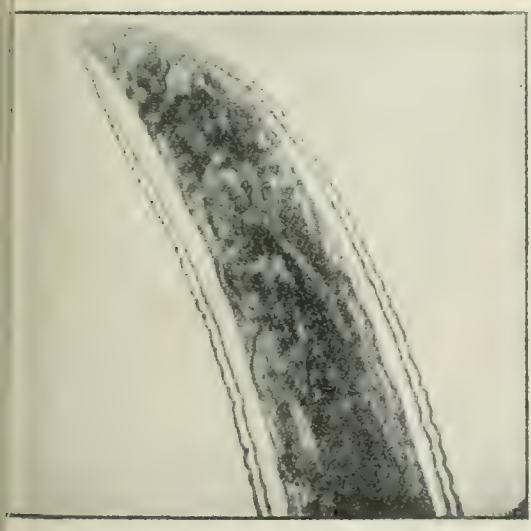


FIG. 22.—Head of *Filaria palpebralis*. (× 80.)

FIG. 23.—*Filaria palpebralis*. (Nat. size.)



G. 24.—Tail of female, *Filaria palpebralis*. (× 80.)

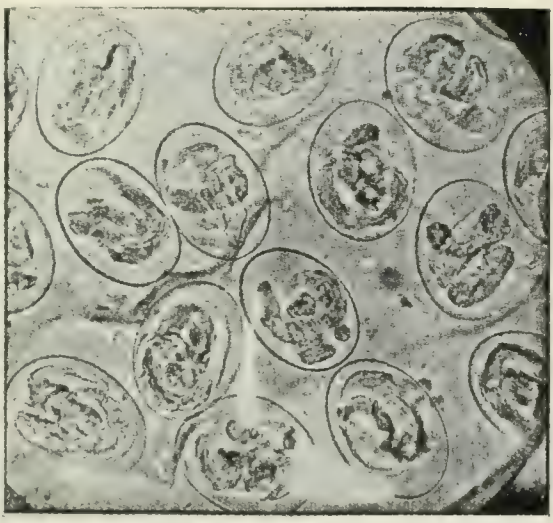


FIG. 25.—Embryos of *Filaria palpebralis*. (× 320.)

The above illustrations are from the *British Journal of Ophthalmology*.

in equines and bovines; they differ from *Filaria* worms in important respects. A considerable number of species have been found in recent years in mammals and birds. All those which inhabit the eyes of mammals are confined to the genus *Thelazia*, and those at present under discussion are thought by Leiper to be examples of the species *Thelazia callipœda*, which is apparently a common eye-worm in the dog in Asia, and which was first recorded from the Punjab by Railliet and Henry in 1910.

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CHAPTER VII

ANKYLOSTOMIASIS

Two kinds of hook-worm, parasitic on man, are found in great abundance in many countries, namely, *Ankylostomum duodenale* and *Necator americanus* (Figs. 26 to 30). The former is largely sub-tropical in distribution; the latter is tropical, being prevalent in the equatorial parts of Africa and America. The symptoms produced by both species are alike, and are commonly attributed to two factors—(1) The general and profound anæmia caused by the long-continued loss of blood; and (2) the action of toxins, evolved by the parasites, and circulating throughout the body. The term ankylostomiasis is applied to both conditions indifferently.

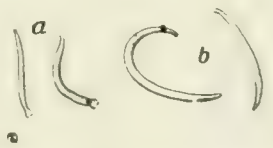

FIG. 26.—*Ankylostomum duodenale.* (Natural size.) (Dubini.) *a*, male; *b*, female. *ex* Manson's *Tropical Diseases.*

SIGNS AND SYMPTOMS.—There is a considerable amount of difference of opinion as to the symptoms which should be attributed to the action of these parasites. Some observers seem inclined to put down every eye trouble they find in an infested district to the agency of these blood-sucking worms; others are sceptical, and doubt whether the phenomena noted are anything more than the outcome of extreme anæmia. Some of the rarer manifestations which have been listed might possibly be more correctly attributed to accidental coincidence. Such complaints as *asthenopia, blurring of vision, diplopia, mydriasis,* and *night-blindness* require little explanation beyond that of the general depression of health, consequent on long-continued loss of blood. Given other exciting conditions, the same might probably be said of *nystagmus, amblyopia,* and *restrictions of the visual field.*

Ashford, Calhoun, and others have maintained that *cataract* in young people is comparatively common amongst those who suffer from hook-worm disease; they believe it is a direct result of the condition.

Fig. 27. — *Ankylostomum duodenale*, female. (After Looss.) *ex* Manson's *Tropical Diseases.*

Fig. 28. — *Ankylostomum duodenale*, male. (After Looss.) *ex* Manson's *Tropical Diseases.*

Fundus Changes. — The retina may appear anæmic, with thin vessels, pale blood columns, arterial pulse and hæmorrhages. Some have described the vessel walls as being flattened out like ribbons. The arterial pulse is explained by the intra-ocular pressure remaining normal, while that in the central artery falls in common with the general systemic arterial pressure. The same condition is, in fact, established as that met with in glaucoma, except that in this case it is the intra-ocular pressure which remains stationary, while the arterial pressure varies, whereas in glaucoma the opposite condition holds. The retinal hæmorrhages, met with in extreme anæmia (especially in pernicious anæmia and in a number of other serious blood conditions), have been ascribed to an alteration in

the composition of the blood affecting the vessel walls. It has been suggested that this effect is exaggerated in ankylostomasis, by the action of toxins evolved by the parasites ; in favour of this view, it is pointed out that these retinal hæmorrhages only occur at a very late stage, when the anæmia is highly marked. It is suggested that the toxins injure the endothelium of the vessel walls. At the same time, the diminution in the force of the circulation may be assumed to be a factor in favour of diapedesis, thus paving the way for the advent of more serious changes. It has been claimed that the retinal hæmorrhages of hookworm disease are characteristic, in that they are more numerous and earlier in the periphery than toward the centre of the fundus, and that they are massed in punctate groups.

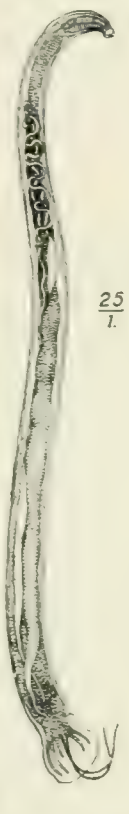

Fig. 29. — *Necator americanus*, male. (After Placencia.) *ex* Manson's *Tropical Diseases.*

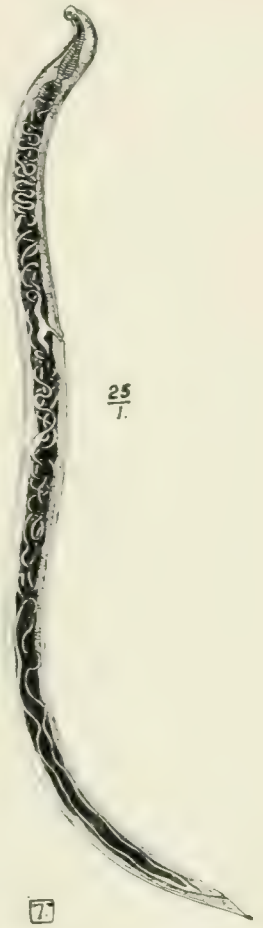

Fig. 30. — *Necator americanus*, female. (After Placencia.) *ex* Manson's *Tropical Diseases.*

Bietti's much-quoted case of *amblyopia* and *central scotoma* may conceivably be capable of another explanation ; but it receives some support from Inouye's record of a Japanese peasant who suffered from a *retrobulbar neuritis*, which cleared up quickly, as soon as the worms were removed by treatment with thymol.

In conclusion, some idea of the importance attached to the eye symptoms of ankylostomiasis may be gained by a

perusal of the following remarks, penned by Ashford, for Byam's new work on *The Practice of Medicine in the Tropics*. He there writes :

"**Eye.**—From 7 to 8 per cent. are apt to show changes in the fundus oculi. 70 per cent. of our cases for special study had some abnormality referable to the eye. It is rare to find changes corresponding to those of albuminuric retinitis, but pulsation of the veins, lowered intra-ocular pressure, pronounced tortuosity of veins and retinal hæmorrhages are not infrequent. We saw a goodly number of cases of nystagmus, and some of sudden blindness not attributable to the anthelminthic. Night-blindness was not rare among our cases."

Treatment.—Darling has recently studied the relative value of the various vermicides in the treatment of hook-worm infection. He finds oil of chenopodium by far the most efficient of all the remedies with which he experimented. Thymol came next in order ; eucalyptus and betanaphthol were far behind. The dose of the oil which he recommends is 1 c.c., in capsule form, repeated after an interval of two hours. The necator worms are less resistant to the treatment than the ankylostomes. A free purgative is given, to ensure that the intestines are empty before the oil is administered ; with the same end in view, rice-gruel diet is all that is allowed the night before the administration, whilst, on the morning itself, only milk is permitted to be given. A second purge ensures the evacuation of the poisoned worms, and of the poison itself, at as early a date as is possible.

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PART III

ARTHROPODA

CHAPTER I

INTRODUCTORY

It is impossible for the student to understand this subject, unless he first masters certain elementary entomological facts.

The insects are a well-defined class of the Arthropod phylum. Amongst them are included a number of Orders, not the least important of which are the flies or Diptera [1] (Gr. δίπτερος = with two wings).

Flies are grouped in five co-ordinate sections as follows —(*a*) The Midge or Mosquito section, with elongate, slender body and filamentous antennæ; (*b*) the Gadfly and Robberfly section, with non-filiform antennæ, an intricate wing-venation, and a proboscis fortified with trenchant stylets; (*c*) the Hover-fly section, having a superficial resemblance to bees and wasps; (*d*) the *Muscoid* or House-fly section, with drooping antennæ, a simple wing-venation, and a simple, unfortified proboscis; and (*e*) the Horse-fly and Sheep-ked section, which are highly modified, more or less bizarre parasites of certain mammals and birds.

The large Muscoid section includes two subordinate groups, namely, *Acalyptrata* and *Calyptrata*. The *Acalyptrates*, which are mostly of small or even minute size, commonly breed in decomposing matter, such as rotting

[1] The Diptera are insects with piercing and sucking mouth parts. The anterior wings are membranous; the posterior are replaced by knobbed processes, used for balancing—the halteres. The prothorax is fused with the rest of the thorax. The metamorphosis is complete (Shipley).

fruit ; some of them, at certain seasons in warm countries, give trouble by their persistent swarming about the eyes.

Of the *Calyptrates* three families are of pertinent interest, namely, the *Muscidæ*, the *Œstridæ*, and the *Sarcophagidæ* ; and perhaps a fourth — the *Anthomyidæ*— deserves mention also.

The MUSCIDÆ include a number of genera, of which the following concern us closely : *Musca*, *Calliphora*, *Chrysomyia*, *Lucilia*, and *Cordylobia*. It is necessary to say a few words about each.

Musca is best represented by the common house-fly, *M. domestica*, which is found all over the world. It breeds in manure heaps and in all kinds of domestic and *bazaar* rubbish. Its larva, or maggot, resembles a small white worm.

Calliphora.—Blue-bottles or blow-flies. These are larger than the house-flies, and vary in colour from blue to black ; they are particularly attracted to meat and offal, on which they lay their eggs in sticky clusters ; they also favour foul wounds.

Lucilia.—These resemble the last-named in their habits, but are of a brilliant metallic green, or a bluish-green colour.

Chrysomyia (gold-fly) is a common cause of myiasis in tropical America ; the habits resemble those of the two preceding genera, and the maggots are found in wounds and in various natural passages. The larvæ form the well-known screw-worms, so called on account of the deep constrictions between the segments of the body.

Cordylobia.—This genus is peculiar to Africa. The notorious species *Cordylobia anthropophaga*, Grunberg (the tumbu-fly), is a subcutaneous parasite of man and other animals in many parts of Africa.

Family ŒSTRIDÆ.—Bot-flies (Lat. *Œstrus*=a fly that drives to frenzy). The most important genera are :

Œstrus, which is parasitic in the nasal passages and sinuses of sheep, and which is known to infest man, but is believed to give rise usually to mild symptoms.

Hypoderma, so called owing to the position in which the

maggots are found. One species, *H. bovis*, will be mentioned later. It would appear to have a most unusual

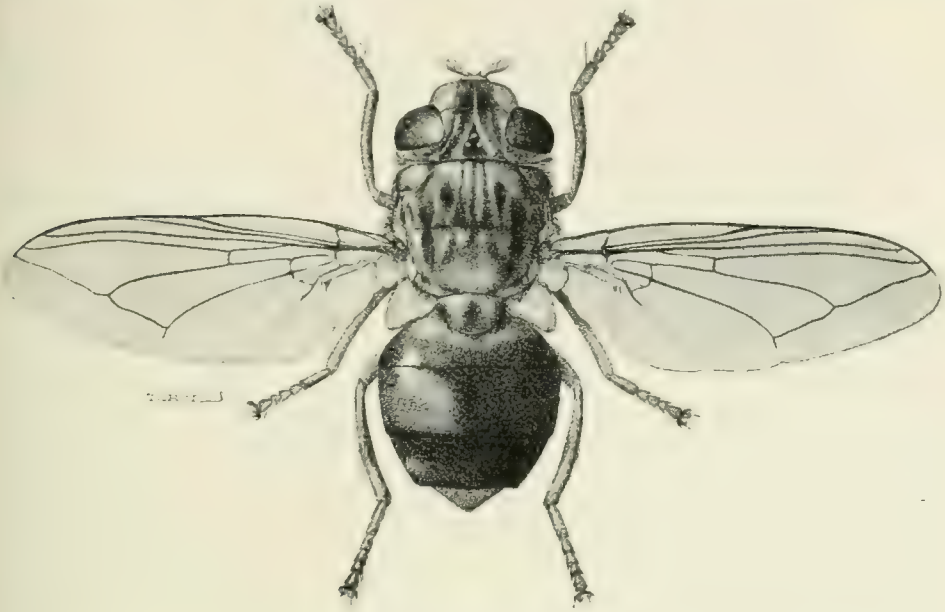

FIG. 31.—*Dermatobia hominis.* (Illustration supplied by Dr. Sambon.)

tendency to invade the interior of the eye. In every instance in which an endocular parasite has been identified by a competent authority, the larva has belonged to this species.

Dermatobia, the best-known species of which is the "Macaw worm" (*Dermatobia noxialis*) of tropical America and the West Indies. *D. cyaniventris* will be referred to later.

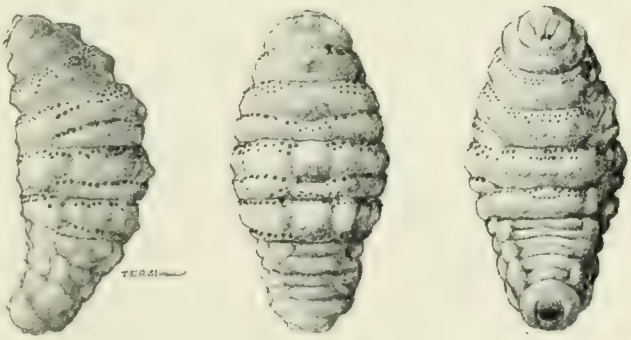

FIG. 32.—The maggot of *Dermatobia hominis* shown from side, back, and ventral surface.

Family SARCOPHAGIDÆ.—Flesh-flies (σάρξ = flesh; φαγεῖν = to eat). These flies have the habits of blow-flies, but are distinguished from the Muscidæ by certain familiar characteristics. Many of them are viviparous producing

numerous small maggots at a birth. The larvæ are partial to filth and carrion of all sorts, and are not infrequently found in wounds and in the natural passages of man. It is sometimes stated that they are less virulent in their action than the maggots of the Muscidæ, but this would appear to be too charitable a view of their activities, for they may wreak the most frightful havoc on the tissues of their unwilling hosts, rivalling even the screw-worms, which to some extent they resemble, save that their spines are more minute than those of the larvæ of Chrysomyia.

Family Anthomyidæ.—To this family belongs the "lesser house-fly," an insect, often abundant in houses, which has the same habits as the house-fly.

The student will find much additional information in the two works mentioned under the References. It will be seen that the list of species whose larvæ attack the human eye is already a long one, but there can be little doubt that it might and will be much extended in the near future. This work lies to the hand of the tropical practitioner, and it is incumbent on him to keep awake to the possibilities offered by a most fascinating and valuable field of research. Every larva should be placed, immediately on removal, in 70 to 85 per cent. alcohol, to which has been added 5 to 10 per cent. of glycerine, and should be dispatched without delay to a competent entomologist for report. Those who are not in touch with such an expert, will always find a welcome for their material in the laboratories of The London School of Tropical Medicine, Endsleigh Gardens, London N.W. 1.[1]

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[1] The author is much indebted to Col. Alcock for assistance in the writing of this chapter.

CHAPTER II

OCULAR MYIASIS

HUMAN myiasis is rare in Western Europe, relatively frequent in Russia, and very prevalent in Mexico and in many parts of the Tropics. Its incidence is favoured by the neighbourhood of animals, and it flourishes under the reign of dirt, carelessness, and neglect. If we remember the abundant insect fauna of the Tropics on the one hand, and the habits of the people who live in these lands on the other, we have a ready explanation of the frequency of myiasis in such parts of the world.

The term includes a great variety of conditions, which differ in origin, in severity, and in clinical course. Such differences depend on several factors—(1) *The species of insect* whose larvæ are concerned ; thus it is believed that those belonging to the Muscidæ are more dangerous than those of the Œstridæ or of the Sarcophagidæ. (2) *The state of health of the subject* ; the sufferers are often neglected, half-starved, emaciated, disease-ridden or wounded people, and it has been suggested that the fœtor which emanates from them may so closely resemble that of the decomposing matter which naturally attracts the fly, as to mislead the insect to lay its eggs on what is really an abnormal nidus. (3) *The intensity of the infection* ; where only a few larvæ are implanted, the symptoms are naturally circumscribed, whereas, when a large number of eggs are laid on a wound, or on the surface of a mucous membrane, either of which emits offensive discharges, the larvæ burrow in large numbers into the adjacent tissues and cause the most appalling destruction of the surrounding parts. The former condition is well illustrated by the author's case of a single screw-worm found under the conjunctiva

of an Indian child, whilst the latter is vividly depicted in Stitt's description of the havoc wrought by the screw-worm larvæ of what was evidently a closely allied fly, *Chrysomyia macellaria*. (4) *The time that is allowed to elapse* before measures are taken to stop the invasion of the tissues by the parasites. It is quite certain that this time-factor is an extraordinarily important element in determining the severity of the symptoms. Infection, even by large numbers of maggots, and those, too, of a dangerous form, can be speedily extinguished if suitable means are taken sufficiently early.

Habits of the Flies.—Some of the flies are oviparous, and lay their eggs on any suitable soil, leaving them to hatch out in due course. Amongst such are the house-flies, the blue-bottles, the green-bottles, and the very dangerous species belonging to the genus *Chrysomyia*. There are other flies which deposit their ova beneath the mucous membrane; for this purpose they are provided with penetrating organs, known as ovipositors, which in some species are capable of piercing even very tough structures. Then, again, there are flies which are viviparous, and which deposit living larvæ, the eggs being hatched whilst still in the insect's vagina; amongst these are to be included the Sarcophagidæ. An interesting question arises as to the manner in which these larvæ are deposited on the mucous membrane. In some, this would appear to be done by the insect settling on the part, in the same manner as the ovipara do. This is probably the usual method, but there is evidence of quite another *modus agendi*: The burdened mother-fly, winging its way rapidly through the air, strikes against an eye, and in doing so contrives to deposit its offspring in one or other fornix of the conjunctiva, where it leaves it to shift for itself (Betti).

It is stated that there is in South America an insect that flies by night, and that strikes against the eye, leaving its anterior horn embedded in the cornea (Ruata). Is it possible that this is a legend founded on the habits of these viviparous insects which we have been discussing?

The Behaviour of the Larvæ.—As has already been in-

dicated, the behaviour of the larvæ varies greatly in different species. In some they appear simply to multiply in the conjunctival sac, or to find their way down the lachrymal passages, or into any of the neighbouring sinuses. The condition is offensive and disgusting, but it does not approach in seriousness that in which the parasites eat their way through all the surrounding structures. The amount of damage that may thus be done is probably seen at its maximum in tropical countries. Anything more foul and awful than an orbit converted into a huge suppurating cavern, filled with crawling maggots, it would be hard to imagine. The stench is appalling, the destruction of tissues in the time is almost incredible, and the patient's condition bears ample testimony to the terrific drain of this septic sore on his strength. Unless rapidly relieved, he will sink into apathy and coma, which may soon end in death. For an excellent description of cases of the kind, the reader is referred to Wahba's experience in Egypt: Large holes were present in each canthus, from which the heads of the worms projected and through which they were removed. In these cases the parasites were of the family of the Muscidæ, and were identified as belonging to a species (*Cordylobia anthropophaga*), related to that of certain larvæ, which are known to burrow beneath the skin of man, dogs and other animals living in various parts of what was formerly German East Africa, in Senegal, and in South Africa. In the discussion which followed Wahba's paper, a number of other surgeons, practising in Egypt, mentioned that they had met with similar cases.

Symptoms and Diagnosis.—It will have been gathered from what has already been said, that the clinical course of cases of myiasis differs enormously in different patients. It will simplify the subject to adopt a classification into (1) the slight, (2) the severe, and (3) the intra-ocular cases. We shall take these in turn.

1. *The mild Cases of Myiasis.*—Farmakovski, speaking from Russian experience, has issued a warning as to the danger of the surgeon overlooking the cause of some forms of larval conjunctivitis. He illustrates his contention by

the clinical history of a boy of 5, admitted to the dispensary after suffering for some hours from pain in the eye. A careful examination revealed several dark moving spots, which appeared to be endeavouring to escape from observation by hiding in the depth of the conjunctival sac. On attempting to remove them they became firmly attached ; a 4 per cent. solution of cocaine paralysed their movements, and resulted in the capture of several small, transparent larvæ, from each of whose heads projected two dark hooks, whereby the animals clung to the conjunctiva. It was these hooks that had led, by their dark colour, to the detection of the presence of the parasites.

Similar cases have been reported in Sicily of *Œstrus ovis*, a sheep larva met with in the mountains of that country. This parasite gives rise to a conjunctivitis which subsides after lasting several days ; but that of the Russian type (*Rhinœstrus purpureus*) is said to be much more dangerous, since, if left alone, it burrows into the depth of the eye and so destroys the organ. The moral of Farmakovski's paper is, that such cases should be recognised at an early stage, when the symptoms are still slight, and when a cure by the removal of the parasite is an easy matter. The lessons he teaches deserve the close attention of tropical practitioners, especially in view of the observations that have recently been made in China on human thelaziasis. (*Vide* Chapter VI. of this section.)

From these cases, whose symptoms, in the initial stages at least, are so slight as to demand the greatest care for their detection, we can pass by gradual steps in the direction of our second or severe class, citing instances on the way. The author published the notes of a screw-worm beneath the conjunctiva of a Hindu child of 7 ; this gave rise to a small tumour in the neighbourhood of the lower fornix, attended by some congestion of the conjunctiva, but quite unaccompanied by pain. A dense small cyst with a sloughy lining was dissected out ; it contained a screw-worm larva (*macellaria*). Then harking back to European experience, we may mention Casalicchio's patient, in whose conjunctival sac twenty-two extremely small larvæ, "apparently

of a muscoid fly, of the group of sarcophagi," were found. Progressing still in order of severity, we come to Guzmann's patient, an extremely poor old woman of 77, who had a violent conjunctival catarrh, with marked swelling and redness of the lids. In the conjunctival sac of each eye there were a large number of small fly larvæ, but the eyes themselves were intact, with the exception of a small marginal ulcer of one cornea.

Before leaving this group of cases, we may mention the symptoms which Betti describes as distinguishing them. The patients complained of itching, burning, and lachrymation, together with the signs of acute conjunctivitis; against the red and swollen conjunctiva can be seen minute living organisms, white in colour, thin and elongated in form, and presenting active vermiform movements. The instillation of cocaine retards the movements of the larvæ, and causes them to become detached so that they can easily be removed with forceps, or even by suction into a pipette.

2. *The severe Cases of Myiasis.*—We have more than once referred to the awful havoc produced by the forms of fly larvæ, which burrow into and feed upon living human tissues. Those of us who have seen such cases are little likely to forget them. Although they are undoubtedly far more common in the Tropics than in Europe, they have, on the whole, been more carefully described in the latter continent. In addition to what has already been quoted, the subject has been dealt with by Reis, and a résumé of the previous literature is given in his article, to which the reader is referred for details. He will there find described the case of an old woman, poor and badly nourished, in whom, at the bottom of an orbital ulcer, were no fewer than 240 larvæ of *Lucilia hominivorax.*

This is probably the right place to mention the observations made by Lagleyze, of Buenos Ayres, on a parasitic skin disease, rare in Argentina, but more frequent in tropical South America, which he found affecting the upper lid and cheek of a sailor, whose ship plied between Buenos Ayres and Paraguay. From incisions in the furuncle-like

and particularly tense tumours of the upper lid, he on several occasions removed larvæ 16 mm. long, which he classified as those of *Dermatobia cyanoventris*.

Remembering the abundant coleopterous fauna of the Tropics, the author feels also constrained to mention here the extraordinary case met with by Boulai, despite the facts that it was a European experience, and that the larva belonged to a beetle and not to a fly. One can imagine the speechless astonishment of the French surgeon when, on incising a small scleral tumour, situated close below the lower corneal margin, there popped out "a small pink larva, 1 c.c. in length, provided with legs, which fell upon the patient's cheek, and, after remaining stationary for a short period, started to walk over the sterile compress which covered the head and face. The larva was that of *larynetes* or of *necrobia*, and it was surmised that the patient introduced the ova of the insect into his conjunctival sac when he was scratching his eye."

3. *Intra-ocular Myiasis.*—Here again, in spite of the fact that the records up to date are all of European cases, the subject is one which is worthy of very close study by tropical practitioners. The author ventures the opinion that, if the latter are only forewarned, it will not be long before they are able to add to the literature of this very interesting subject. The first case we shall mention is that published by Thomas and Parsons, in which the maggot of a blow-fly or of a sarcophagous insect lay across the anterior chamber on the surface of the iris. It had given rise to intense irido-cyclitis, with detachment of the retina, and the eye had to be enucleated. Parsons, in the discussion which followed the reading of Thomas' paper, referred to three previous cases of dipterous larvæ found in the anterior chamber of human beings, in two of which they were definitely described as the larvæ of *Hypoderma bovis*: in the third the species was not determined, though examined by a capable entomologist, who thought that the unusual environment had brought about changes and arrest of the animal's development. Of a fourth case the available information was too scanty to be of much

value. In all the four cases of which notes are available, the subjects were children, aged respectively $2\frac{3}{4}$, 5, $5\frac{1}{2}$, and 9 years. This is a point to which we shall return.

In the discussion, Mackay mentioned yet another instance of what appears to have been a maggot in the anterior chamber of a little child, but the notes were incomplete.

The case published by Hess was likewise in a child of 4. In consequence of a very severe inflammation the eye was enucleated; the retina was totally detached and thickened, and the vitreous was opaque and degenerate. In the partly-coagulated subretinal fluid was found the larva of a fly (*Hypoderma bovis*), 15 mm. in length and in the first stage of growth. Hess surmised that the larva had been introduced by the blood-stream, and this view was supported by Grunberg, of the Zoological Museum at Berlin, who stated that the larvæ of Hypoderma reach their resting-place under the skin after circuitous wanderings through the body of their host.

Parsons held a different opinion. He pointed out (*loc. cit.*) that all the subjects were young children, and that in such patients the sclerotic is not so hard as it is in adults. He thought that the larva was deposited in the conjunctival sac and bored its way through the sclera. Such an achievement is well within what we know of the powers of these animals in general, and of *H. bovis* in particular. He thought that it would be difficult to explain the presence of the parasite in the anterior chamber in all of the cases he had been able to have under review, if the idea was correct that it got into the eye by the blood-stream. In Hess' case, the maggot lay beneath the retina, but it may easily have bored its way in there from the fornix. The suggestion that the ovum might by accident have been implanted in a blood vessel, such as the lachrymal artery, and then have worked its way along the current into the eyeball, appears very far-fetched. Nor is it reasonable to suppose that the ova passed first into the veins, and then worked their way round through the circulation; their size prohibits such a view.

Treatment.—The indications for treatment have been

pointed out already. In any case they are sufficiently obvious. Encysted larvæ must be removed by incision; those, lying in the conjunctival sac, or burrowing in the tissues, must be killed and washed out with the aid of antiseptic solutions. Chloroform water, or a 5 per cent. solution of carbolic acid, or of compound cresol, is stated by Stitt to give the best results in practice. Alcock recommends the use of an emulsion of chloroform and turpentine in a watery solution of boracic acid, combined with free irrigations of a solution of permanganate of potash, the latter being designed to quell "the fearful stench." A combination of chloroform to narcotise the larvæ, and of carbolic acid to destroy them, would probably be even better still. Where cocaine can be safely used it proves of great value, inasmuch as it paralyses the larvæ and causes them to let go their hold; they are then very easily removed. The use of a mercurial ointment to plug the cavities makes certain of the death of any remaining parasites. The symptoms subside immediately on the removal of the cause, but the patient's strength must be conserved and restored by careful diet, stimulation, and nursing.

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PART IV

MISCELLANEOUS

THERE remain for consideration certain conditions, of which but little is known, and whose exact classification is attended with some difficulty. Each will be discussed in turn.

CHAPTER I

RHINOSPORIDIUM KINEALYI

This disease is probably not very uncommon in India, but it has attracted little notice hitherto. This is probably due to the fact that the signs and symptoms to which it gives rise are not very distinctive, the consequence being that the source of the trouble is very frequently overlooked. It is much better known as a cause of growths in the nasopharynx and nasal cavities. The earliest record of it in connection with the eye is in a case published by the author in collaboration with A. C. Ingram. It occurred in a Mohammedan male, aged 60. Five years earlier, he noticed a small painless growth (about 5 mm. by 3 mm.), a quarter of an inch below the outer third of the lower lid. This had been steadily growing ever since its first appearance. Two years later, another small growth was observed on the inner surface of the outer third of the same lid. This, too, continued to grow without causing him any discomfort. When he presented himself at the Madras Ophthalmic Hospital, three distinct masses were present—(1) A pendulous, semicircular, cutaneous overgrowth, loosely overhanging the upper part of the right superior maxillary region; this measured 20 mm. horizontally along its upper border, 13 mm. vertically, and 9 mm. in thickness from before backwards. It had a fibrous feel, and was not adherent to the deeper structures. There was a slight mechanical ectropion of the lower lid due to the weight of the growth. These points are well shown in Fig. 33. (2) On everting the lower lid, a reddish, irregular granular mass was seen projecting inwards on its temporal two-thirds; a number of white dots on its surface appeared to be due to retained

secretion. The growth had a somewhat gelatinous appearance, and enlarged tortuous vessels could be seen over its surface. On pinching up the skin fold from outside the palpebral mass could be felt projecting between the folds. On pressure, thick creamy pus escaped from the

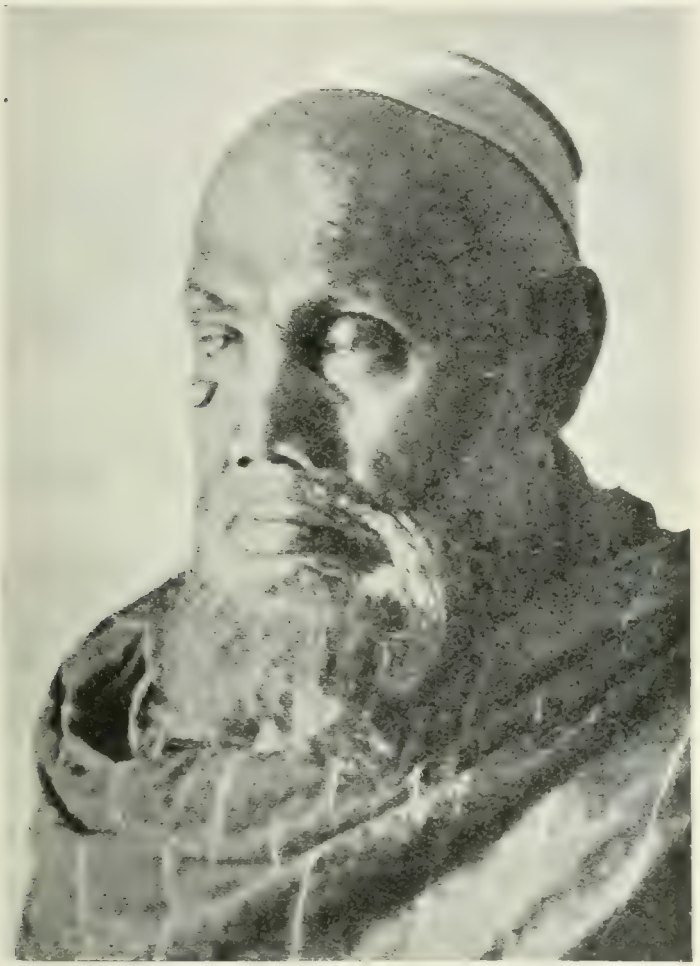


FIG. 33.—Patient suffering from invasion of the parts about the right eye by *Rhinosporidium kinealyi*. (ex. *The Ophthalmoscope.*)

follicles, and the patient complained of some pain. (3) Close to the inner canthus there was an elastic rounded tumour, which gave the impression of containing tense fluid. The skin was freely movable over it, and it lay in the segment of the orbit, downward and internal to the eye. It appeared to have contracted adhesions to the

surrounding parts. It could not be emptied on pressure. It lay very distinctly below and to the outer side of what would have been the position of a dilated lachrymal sac. It was tender to pressure and could not be emptied thereby.

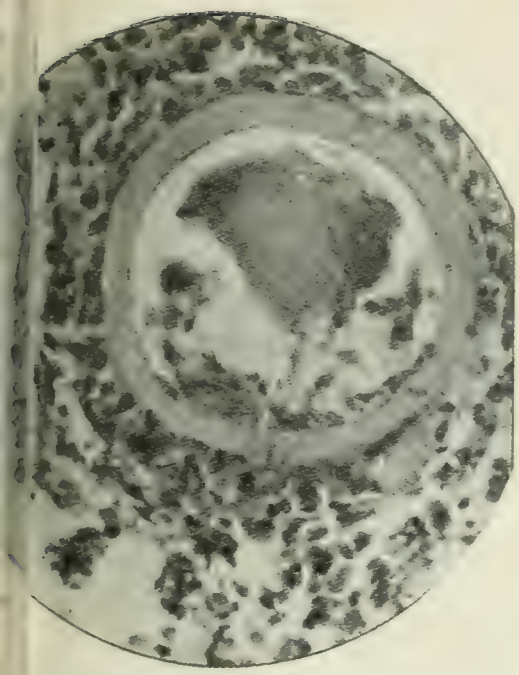
Operation.—The œdematous hypertrophied flap of skin was dissected out, together with the underlying tumour, and with that portion of the conjunctiva, which was adherent to its surface. The tumour on the inner side was also removed ; it went rather far back into the orbit, and troublesome hæmorrhage attended the operation. The growth felt elastic, and appeared on removal to be a cyst, 12 mm. in diameter and containing a mass of blood clot.

Pathological Report.—The cutaneous portion consisted of fibrous connective tissue, with some irregular proliferation, covered by a flattened layer of stratified epithelium. There was one large irregular cystic space, which was taken to be an old blood cyst with degenerate contents.

The conjunctival polypus consisted of fibrous and fibro-cellular tissue, containing a large number of typical cysts of *Rhinosporidium kinealyi*. These were of all sizes and were irregularly scattered through the tissue. The surface of the polypus was covered by an irregular layer of transitional epithelium ; close to this were a number of large cystic spaces, full of granular material. These large cysts were almost all lined by an irregular layer of epithelium, derived from the conjunctiva, and some contained degenerate leucocytes in their granular contents. Almost all the parasitic cysts were more or less distorted and degenerate.

The mass from the orbit resembled the first described tumour in structure, but was less fibrous and contained a great many well-formed cysts of *R. kinealyi* ; a few of these were barren and degenerate ; some of them showed well the formation of the pore in the wall described by O'Kinealy. The conjunctiva does not appear to be so favourable a nidus for the parasite as the nose and pharynx, as all the polypi recorded in it have been much smaller than those found in the latter situations.

In the same communication are reported two other



4.—Cyst emptied of spore morulæ and
ded by connective-tissue cells. Giant-
formation. Note appearance suggest-
of a pore in cyst wall. (× about 700.)

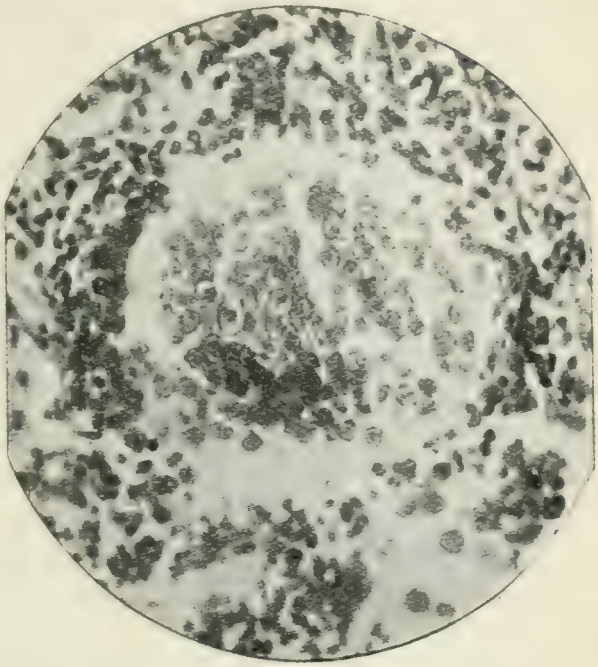


FIG. 35.—Cyst from which spore morulæ are escaping into the surrounding granulation tissue. The cyst wall is degenerating. (× about 700.)

36. — Showing large number of cysts
the outer surface of growth. (× about
0.)

FIG. 37.—Young granulation tissue containing cysts in various stages. A large cyst is undergoing organisation. (× about 450.)

NOTE.—The above illustrations are all from *The Ophthalmoscope*.

cases of this affection, which had previously been seen by Kirkpatrick, who mentioned that rhinosporidium affecting the nasal passages has a very characteristic appearance, if in an advanced stage: for it forms long finger-like processes, having semi-transparent edges and a band of fibrous tissue running down the middle, like the mid-rib of a leaf. Kirkpatrick believes this appearance to be so distinctive in typical cases that it is possible to recognise the nature of the conjunctival tumour before removal.

Sections of Kirkpatrick's cases closely resembled those of the nasal growths examined by Beattie: a central core of fibrous tissue, which was rather œdematous and contained an occasional cyst separated the surfaces; the outer or more superficial part consisted of young granulation tissue, in which were embedded an enormous number of cysts of all sizes and in varying stages of development. Most of these were empty, but a few contained some pure morulæ, which could, in some instances, be seen pouring out of the cysts into the surrounding granulation tissue. A fair number of the cysts were becoming organised, giant-cell formation being common. An appearance suggestive of a pore was seen here and there; but the existence of pores is always difficult of demonstration in stained sections, although they are very clearly visible in fresh, teased material. The microphotographs admirably demonstrate the points described. (Figs. 34–37.)

Tirumurti, in 1915, reported having again found the sporozoon in the conjunctiva, and stated that it was transmitted by direct infection through the hands, handkerchiefs, or clothing.

Rhinosporidium of the Lachrymal Sac.

In 1916, Kirkpatrick described what, we believe, is the first and only recorded instance of this growth in connection with the lachrymal passages. The patient was again a male Mohammedan, and his age was 32. The swelling at the inner side of his left orbit occasionally gave him slight pain. He had noticed it for a year: at

first it was intermittent and caused no lachrymation, but it had grown, and with its growth the symptoms had become intensified. The distended sac was somewhat larger than a kidney bean, it was rounded and extended farther outwards along the lower margin of the orbit than a dilated lachrymal sac usually does. The skin

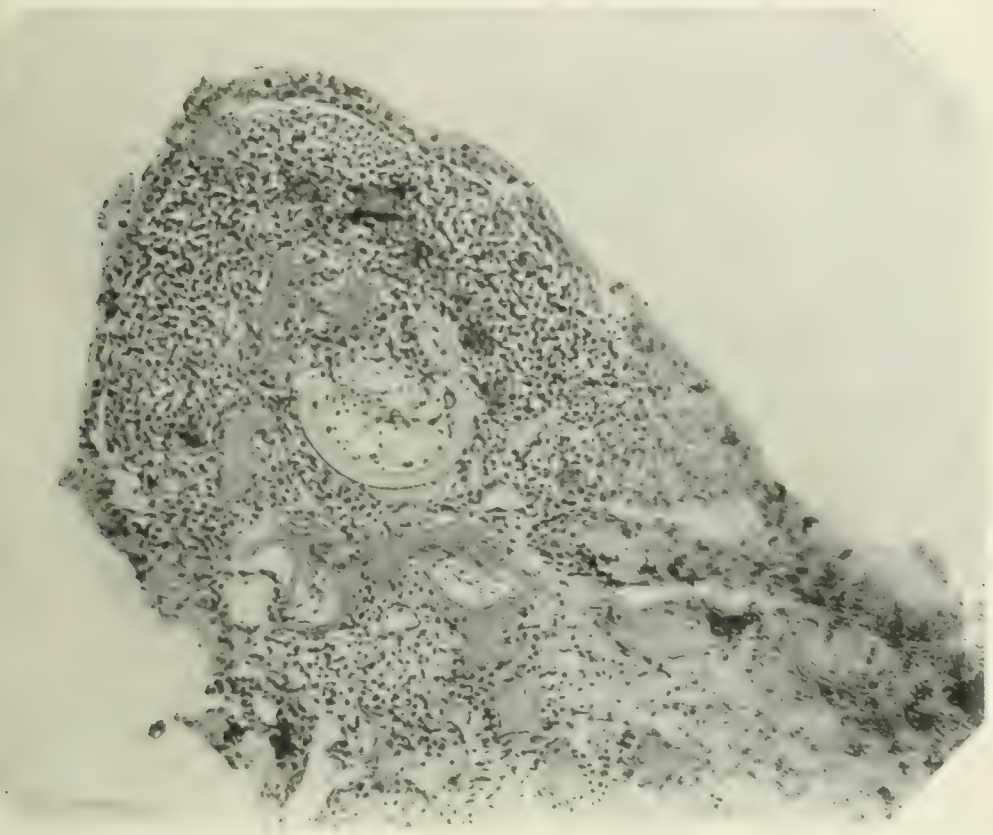


FIG. 38.—Rhinosporidium of the Lachrymal Sac. The section shows a granulation tissue rich in plasma cells. A large discharged cyst lies in the subepithelial tissue; in its neighbourhood are a number of shrunken empty cysts. (H. Kirkpatrick.) (ex. *The Ophthalmoscope.*)

covering it was slightly inflamed, and on pressure the swelling disappeared, a quantity of pus, at the same time, passing into the left nostril.

The sac was excised, and was found to be partly disorganised, and to have soft walls, lined by a granulation tissue, which formed very small polypoid growths. The bony bed of the sac was inflamed, and the sac had blended with the inflamed orbital tissues on its outer side. It

contained creamy pus and there was free hæmorrhage during its removal, just as in the author's case. The wound healed well, but recurrence took place a month later, and a second operation had to be performed. The lachrymal groove was partly carious. The cavity was thoroughly scraped and irrigated with a solution of quinine 10 gr. to the ounce. Ten months later there was no sign of recurrence, and the amount of scarring present was so slight as to make it difficult to believe that such excessive damage to the tissues had originally occurred. No trace of the disease could be detected in the nose or nasopharynx. The use of quinine in this connection is worth noticing, as without it Kirkpatrick has found these growths difficult to eradicate. Niblock, acting on his suggestion, has since used quinine for nasopharyngeal rhinosporidium with very satisfactory results. Fig. 38 illustrates the pathological features of the case in question.

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CHAPTER II

MYCETOMA

This disease is caused by one or other of a variety of fungi. It is endemic in certain districts, and is widely known as "Madura Foot," from the fact that it is so prevalent in Madura, one of the districts of the Southern Presidency of India. It occurs, however, in many other parts of India, and also in Egypt and in various other parts of Africa. It usually attacks the feet, and it is supposed that the fungi live as parasites on certain plants, and are accidentally carried into the naked feet of agriculturists and others, by means of wounds inflicted by thorns, sharp blades of grass, etc. During the many years of the author's experience in Madras, he neither saw nor heard of a single instance of mycetoma occurring in the eye or in its neighbourhood. A case has, however, been recently published in which the orbit was the seat of the growth of this fungus, and it would therefore seem well worth while for tropical practitioners to be on the look-out for any further instances of this rare condition.

CHAPTER III

ASPERGILLOSIS

This condition has not uncommonly been met with in various parts of the world affecting the cornea, and has been described as keratomycosis. Hajano reports a case from Japan, in which the fungus causing the lesion was *Aspergillus fumigatus*, a species which has also been incriminated in records from other parts of the world. During his term in Madras, the author met with several cases of fungoid infection of the cornea, and remembers, with deep regret, that he was unable either to identify the organism or to get this done for him. He therefore desires to draw special attention to the subject in the hope that others, who have the same opportunities, will be less remiss than he was. The development of the Tata Research scheme in India, and of similar institutions in other backward countries, should make the task of identification of these fungi much easier than it used to be.

It is not an uncommon thing for natives to receive wounds of the eye when moving about at night in the country districts, and the history of such an injury is far from infrequent, in the out-patient room, in those who come with ulcer of the cornea, which is often attended by hypopyon. Every such ulcer deserves that its scrapings should be submitted to careful microscopic examination. We know, of course, that many of them are pneumococcal in origin, but the writer believes that systematic work in this

direction will be attended by the attainment of interesting and unexpected findings.

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CHAPTER IV

MURMEKIASMOSIS AMPHILAPHES

Chalmers and Christopherson have described a peculiar form of cutaneous wart, characterised by an extraordinary

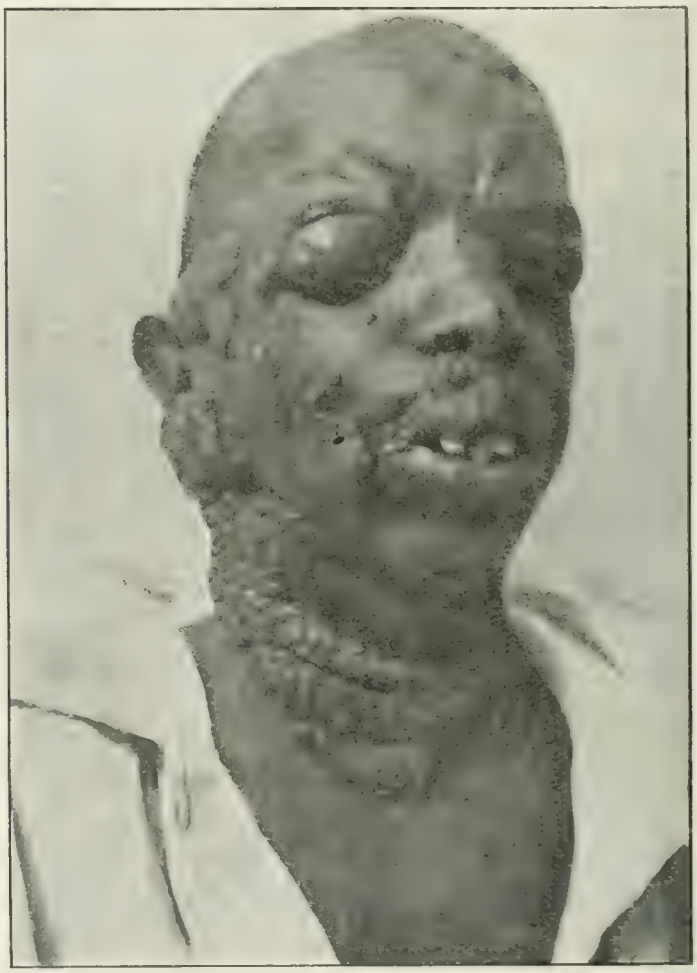

Fig. 39.—Murmekiasmosis. (ex. *Journ. Trop. Med. and Hyg.*)

facility for growth, which in their patient, an Arab aged 16, caused it to spread and to occupy practically the whole of

the right side of the face and neck, and to destroy the right eye, besides invading other structures. Operation is called

FIG. 40.—A curious fibromatous condition of the skin, in an Indian. (R. H. Elliot.)

for at an early stage, and is then very satisfactory. Microscopically, the points of interest are the presence in the growth of numerous cryptococci, and the fact that the

cutaneous warts are largely composed of an adenoma derived from the sebaceous glands.

The attack on the eye was evidently due to the accident of position. The author met in Madras with a case which, in the photographs at least, is indistinguishable from the one above described, except that it attacked a somewhat different part of the body. The illustrations are placed side by side for purposes of comparison. (Figs. 39 and 40.)

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Chalmers, A. J., and Christopherson, J. B.—*Journ. Trop. Med. and Hyg.*, May 1, 1914, No. 9, p. 129.

SECTION VI

THE INDIAN OPERATION OF COUCHING FOR CATARACT

Chapter I. Historical.

,, II. The Technique of Couching.

,, III. The Indian Coucher and his Habits.

,, IV. Statistics.

,, V. Pathology.

,, VI. Diagnosis.

,, VII. Clinical.

CHAPTER I

HISTORICAL

The operation of couching for cataract was practised and described by Celsus, at the very beginning of the Christian era, and a large number of contributions to the literature of the subject have since been made. It is probable that it was introduced into Europe from the East, for it was certainly known and performed in the Orient for many hundreds of years before the first whisper of its advent appeared in the annals of Western surgery. As time went on, the procedure had taken firm root in the West, but the admirable treatise on cataract by James Ware (1812) proved all but a death-blow to it. Notwithstanding this, it was left to Mackenzie, so late as 1854 (4th edition), to give the most complete and interesting description of couching which is to be found anywhere in literature. He distinguished sharply between the operations of depression and reclination. In depression (Fig. 41) the lens is pushed directly below the level of the pupil, being made to follow the curvature of the eye, and thus to sweep over the corpus ciliaræ until it comes to rest on the floor of the eyeball, with its anterior surface directed forwards and downwards. In reclination (Fig. 42) the lens is made to turn over towards the bottom of the vitreous chamber, in such a way that what was formerly its anterior surface now comes to look upwards, and what was its upper edge is turned to the rear. The whole lens is swung backward, as if on a hinge composed of the lower fibres of its suspensory ligament, which still remain unbroken. The whole technique of both these operations, as Mackenzie knew them, will be found fully described in the author's work on *Couching for Cataract*.

From the time of the advent of the British surgeon to India, couching attracted much notice, but, it was not till the work of Lister began to bear fruit, that the crude and filthy methods of the Indian operator excited a due amount of horror in the minds of the exponents of modern surgery. A number of the leading ophthalmic surgeons in the Indian Medical Service have turned their attention to the operation, and the general consensus of opinion amongst them has been very adverse to it. Maynard's evidence was not in its favour ; H. E. Drake-Brockman had nothing too bad to say of it ; and his uncle, E. F. Drake-Brockman, formerly of the Madras Eye Hospital, estimated the coucher's

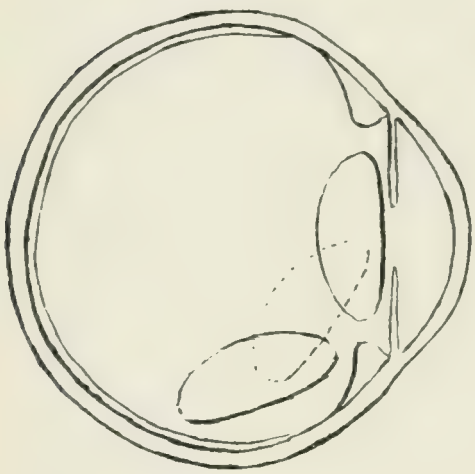

Fig. 41.—Depression.

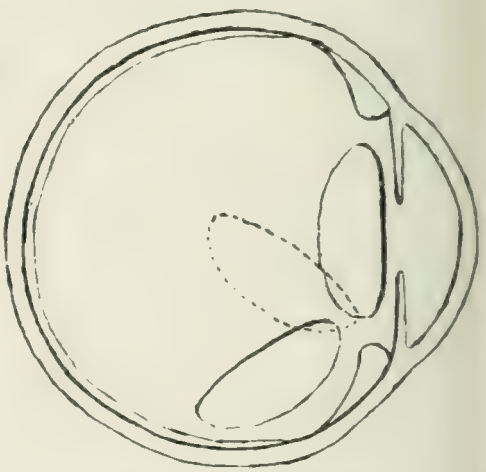

Fig. 42.—Reclination.

successes at not more than 10 per cent. Henry Smith, of Jullundur, who gave the subject his careful attention, expressed the opinion "that lens couching, at the present time, is an operation which should not be practised outside the ranks of charlatans." The writer's contributions, based on a large number of accurate observations, have shown how bad the Indian coucher's results really are, and have been closely confirmed by Kirkpatrick's work.

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[1] The subject of couching for cataract is of very great importance to the tropical practitioner; for this reason it is dealt with at some length in this section. Those who are interested in what is written here, will find a much fuller account of every department of the subject in the author's work referred to above.

CHAPTER II

THE TECHNIQUE OF COUCHING FOR CATARACT

THERE are two distinct methods of operating, which, for the sake of convenience, may be spoken of as the *anterior* and the *posterior*, using the terms relatively to the plane of

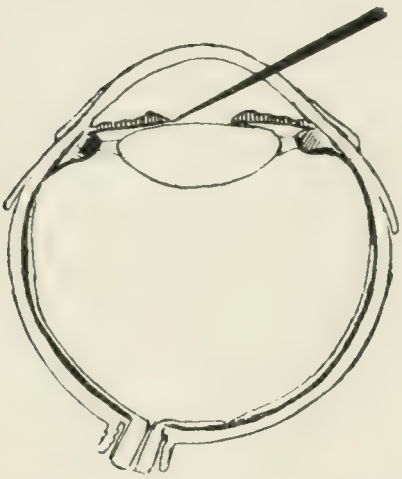

FIG. 43.—The Anterior Operation.

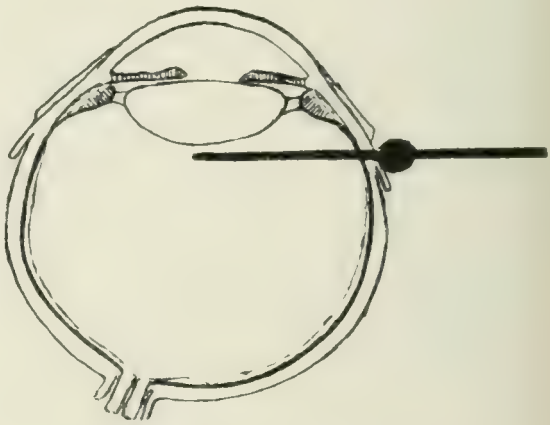

FIG. 44.—The Posterior Operation.

the ciliary body and iris (Figs. 43 and 44). We shall take them in turn.

The Anterior Operation. — The patient and operator squat, facing each other in a good light. (Fig. 45.) The former is told that no operation is to be performed, and that it is merely a question of putting medicine into the eye. He is directed to look downward, and the coucher raises the upper lid with one hand, whilst in the other he conceals either a needle or a sharp thorn. The head is steadied by a friend from behind. The instrument is thrust suddenly through the cornea, and on through the pupil or iris, into the periphery of the lens. The next movement, which is so rapid as almost to melt into the first, is that of depression

or reclination. In this, the spot where the cornea grasps the shaft of the needle serves as a fulcrum. The operator raises his end of the instrument, and the opposite one, which lies either on the surface of the lens or embedded in it, is consequently depressed, thus carrying the cataract with it downwards, or downwards and backwards, and so clearing the pupil. Little pain is complained of by the patients. The sight is next tested by holding up fingers to be counted,

Fig. 45.—The Operation of Couching.

or common objects for identification. The eye is bandaged for at least twenty-four hours, and during that interval, the operator has frequently placed a safe distance between himself and his patients of the day before, and is seeking fresh dupes in another village.

The Posterior Operation. — The surgical equipment for this procedure (Fig. 46) consists of a small lancet-shaped knife, guarded to within a few millimetres of its end by a roll of cotton-wool wrapped round it for the purpose, and of a copper probe 4 inches long and about

1·5 mm. in diameter. A cotton thread, twisted round the probe at a spot 12 mm. from its point, serves the same purpose as the stop in a Bowman's needle. From the point to this stop the instrument is triangular in section. The patient looks well towards the nose, and the surgeon gently marks out the selected spot, by pressing with his thumb-nail on the conjunctiva, about 8 mm. out from the limbus, and a little below the horizontal meridian. The eye is steadied by firm finger pressure exerted through the partly everted lower lid. The coucher takes his lancet in hand ; it will be observed that it would easily pass, as it is meant to do, for a roll of cotton-wool ; this impression is

FIG. 46.—The Instruments used in Couching. The Lancet is seen above, the Probe below.

heightened by covering it with sandal-wood paste, which is described as the "cataract-cleansing drug." Under cover of this suggestion, the lancet is plunged boldly through the sclera at the selected spot. The patient is reassured, being told that the "medicinal application is over," and the copper probe is now taken up and inserted through the wound, up to its stop, being held between the thumb and two fingers ; a circular movement is given to its point, the stop, meanwhile, resting against the sclera at the puncture, and serving as a pivot for the action, whose object is to tear through the suspensory ligament from behind. Immediately following this step, a downward stroke of the point is made in order to depress the now loosened lens. The parade of testing the restored vision is then gone through by the operator.

There is a step of the procedure which has been purposely left to the last, as its interest is psychologic rather than surgical. It is common to both methods of operation, and consists of the anointing of the eye with the blood of a freshly killed fowl. It is a measure in which superstition, cunning, self-preservation, and greed overwhelm and mask a faint and feeble therapeutic design. The sacrificial element is present, for a hazy idea, that the death of the votive bird may turn evil from the patient, looms in the background. Next comes the need to mask the shedding of the patient's blood, since he is often told that no operation is to be performed, but that a mere " medicinal application " is to be made ; the blood of the outraged bird covers the guilt of the vaidyan's falsehood. Largest of all looms the fact that the curry-pot, even of a worker of surgical marvels, needs constant replenishing, and that fowl is an excellent substitute for mutton on such occasions. Lastly, these men seem to believe that the coagulation of the fowl's blood helps to close the puncture. In view of the dirty condition of the instruments which they introduce into the interior of the eye, this last factor may be neglected.

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CHAPTER III

THE INDIAN COUCHER AND HIS HABITS

The coucher goes by different names in different parts of India. In Bengal and in the United and Central Provinces he is known as the *suttya* or *mal*, and in the Punjab as the *rawal*. Ekambaranf, who came into intimate contact with these men in the Madras Presidency, always describes them as *vaidyans*, the term signifying surgeons. In the north they are Hindus, of the Kayasth caste, a class well known for its astuteness and educational qualifications. Drake-Brockman states that in the north Mohammedan couchers are rare, whilst in the Southern Presidency it appears to be the exception to find a Hindu doing such work. Like every other occupation, couching in India is hereditary, the principles of the craft being handed down from father to son by word of mouth and by practical instruction. It has been stated that there is no literature on the subject. This, however, would appear to be a mistake, for Ekambaram learnt that there are "some old texts written on palmyra leaves laying down the method." A literal translation of one of these runs : "Removing the lancet after making a puncture, insert the copper probe ; and holding it with three fingers, depress the lens with the three-sided edge."

By tradition and ancestral habit, the coucher is a wanderer on the face of the earth, and like a gipsy he carries his wares, such as they are, to the very doors of the people's homes ; but it is probable that in each of the large provinces of India these men have a headquarters of their own. This in the Madras Presidency is known as "Kannadiputhur," which signifies the "village of eye operations." During part of the year these men are agriculturists and fishermen ;

but when the dry season robs them of their occupations, they wander forth to practise the art with which their ancestors have been identified from time immemorial. They do not, however, confine themselves to eye operations, but practise as well a crude form of general surgery. Like many other disciples of Æsculapius, their fee is a very elastic one, and, in common with other artists, they learn to know both the smiles and the frowns of fortune. Luxury rarely comes their way, whilst hardship and toil are their constant lot. Their spare evening hours are filled in with such arduous and monotonous occupations as net-weaving; and full many a night they go hungry to sleep, with the sun-baked earth for their only bed.

All who have seen them at work agree that their methods are dirty and septic to a degree, and the oft-expressed wonder has ever been, not that their results are so bad, but that they are ever good. Their surgical equipment is carried in a bag or in a box, which would be considered dirty alongside of the tool-chest or work-basket of any English artisan. The filth alike of their clothes, their hands, and their person, staggers description from a surgical point of view. The exact patterns of the instruments used vary in different parts of India, and so also do some of the couchers' customs. Allusion has already been made to the slaughter of a fowl and the use of its blood in Southern India. This is readily understood, as the Mohammedan couchers are flesh-eaters. In the north, where these experts are Hindus, the fowl plays no part, but a very subtle form of deception is described by Drake-Brockman. Each suttya carries in a little bag a store of pieces of dried membrane. One of these is dropped into water before the operation commences, and is produced at the psychologic moment as evidence that the Indian surgeon can, and does, remove the cataract from the eye, just as much as his Western brother. This tribute to our science is as subtle as it is nefarious. The pieces carried are of various tints, in order that the colour of the cataract, as seen before operation, may be matched as closely as possible.

Ekambaram divides the Indian couchers, with whom he has come into contact, into two classes, the Mohammedan couchers of the south, whose work is mainly met with in Madras, and the Punjabis (people of the Punjab) from the north. The same method of operation is adopted by both, but there would appear to be a great difference between the status and the attainments of the two classes. The Mohammedans are much the lower type; their practice is confined to the villages through which they roam, and they very rarely visit big towns. Their length of stay is limited to one or two days, and they make haste to escape soon after having performed an operation, "for fear of being clubbed for their stupid action." They do not use any form of anæsthetic. On the other hand, the Punjabi couchers are described as intelligent, respectable, decently clad men, who confine their work to the towns, and stay in each place four or five months, amassing considerable wealth thereby. Before couching, they drop into the eye a fine yellow powder, which Ekambaram believes to be stained cocaine. They were, however, extremely secretive on this subject, and refused to part with even a grain of the drug at any price he could offer. Its efficiency is testified to by the fact that the patients remained absolutely quiet and collected during the whole of the operation. The cases are kept under observation for from a week to a month after operation, being made to attend daily. Their results are much better than those obtained by the Mohammedans. Some of the fees they obtain are relatively very large. An idea of their social status may be gathered from the fact that carriages are sent for them by their better-class patients; but, in Ekambaram's opinion, the aristocracy of Indian intelligence is learning to keep aloof from these men, owing to the influence of the Western surgeons, whose method of extraction is steadily establishing itself in the esteem of the people at large. He gives credit to the Punjabis for a more efficient technique of operation than that practised by the Mohammedans.

It has been said of the coucher that he has no diagnostic powers, and it is quite certain that he sometimes couches the

lens in cases of optic atrophy, of glaucoma, and of certain other diseases, in which such a step is useless and worse. It is fair to add that the number of cases of this kind which the writer saw was not large. This observation is the more significant, since he was keenly on the look-out for any instances of the kind, and that, too, during many years of Indian experience in an exceptionally large cataract practice.

A word may not be out of place on the subject of the covering of the head of the patient and surgeon with a cloth, as adopted by some few couchers during the operation. Such a procedure is, from the point of view of lost light, a handicap to the operator, but it has, from his way of looking at it, certain advantages. It shuts the patient off from the distractions of his surroundings, which are otherwise very public ; it hides the actual operative procedure from prying eyes ; and it conceals the facial and other evidence of pain. The greatest factor of all, in an Eastern land, is the air of mystery with which it shrouds the proceeding. The element of *jadu* (magic) so introduced is paramount in its psychologic interest.

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CHAPTER IV

STATISTICS

The conclusions arrived at by the author as to the value of the operation of couching for cataract, are based on a survey of very careful and systematic records of 780 cases seen in the Madras Ophthalmic Hospital. It is important to remember that all the available evidence goes to show that the methods of operating are fundamentally the same, not only in different parts of India, but throughout the whole of the East. Every effort was made to give the coucher fair play. It is even probable that he has had more than fair play, since a large number of eyes are lost after this operation from panophthalmitis, and from shrinkage of the globe, following irido-cyclitis. Patients in such conditions will often stay away from hospital, either because they have lost all hope, or because they do not wish to acknowledge that they have resorted to a form of treatment which they know is disapproved of by English surgeons.

In the first chapter of this Section we have spoken of the very unfavourable views formed by a number of the latter, as to the results of couching.

We are now in a position to discuss some of the lessons to be derived from the Madras statistics. In only 10·59 per cent. was the vision $\frac{1}{3}$ and upward. In another 11·05 per cent. it was $\frac{1}{4}$ to $\frac{1}{10}$, in 9·64 per cent. it was $\frac{1}{11}$ to $\frac{1}{50}$, and in 7·05 per cent. it was a finger-count at 2 feet or less. The figures given refer in each case to the sight corrected with lenses. If every case that got a vision of $\frac{1}{10}$ and upward be considered a success, the coucher can claim 21·64 per cent. Again, if anything from $\frac{1}{10}$ vision to the ability to count fingers close to the face be counted as partial

success, the figure for this class is 16·69 per cent. This is very much more liberal treatment than would be accorded to the cataract statistics of any European surgeon.

A further light is thrown on the above figures by a study of the table showing the duration of vision after couching. Of the 45 successful cases, 23 of them, or more than 50 per cent., had been couched less than two years before; 9 more had been couched between two and three years, and 11 from three to ten years. In 2 this detail was unmarked. The great preponderance of short histories in the cases of successful operation is significant.

We next come to the causes of failure. The figure for iritis and irido-cyclitis stands at 35·76 per cent. of the *total* number of cases; glaucoma accounts for 11·05 per cent., imperfect dislocation of the lens for 8·94 per cent., retinal detachment for 3·53 per cent., optic atrophy (including one case of optic neuritis supervening as a septic complication of the operation) for 2·59 per cent. The rest are minor heads.

In the great majority of cases, ruined by irido-cyclitis, the inflammation set in within a few days of operation; but sometimes this complication was delayed for a long period; indeed, in three cases it came on from one and a half to three years afterwards. In one case at least, sympathetic ophthalmia would appear to have destroyed the second eye two years after the couching.

Similarly, in most cases of glaucoma the access of high tension came on within a few days of operation. Exceptionally, it was months or even years later. Many of the latter would seem to have been associated with irido-cyclitis, and to have been secondary in nature.

In the cases of imperfect dislocation of the cataract, the suspensory ligament appeared to have been incompletely torn, with the result that the lens swung, as it were, on a hinge. Sometimes this hinge lies above, and the cataract falls quite out of the line of sight when the patient is recumbent, but flaps back to block the pupil when the erect attitude is assumed. In other cases, even when the

hinge is laterally placed, the same thing may happen, but much more rarely.

Ten of the cases in which failure was ascribed to optic atrophy showed no improvement in vision after operation. Their histories indicate that the atrophic condition was present before operation, and there seems to be a fair presumption that the coucher mistook the condition for cataract, or at least failed to recognise its true nature. In one case acute optic neuritis appears to have supervened as a septic complication of the operation. This throws an interesting light on the numerous pathological specimens, in which a cone of exudate is found, including the whole of the shrunken vitreous body from the optic papilla to the ora serrata.

There were also a limited number of instances, in which it appeared that the operation of couching had been done in the face of retinitic or of glaucomatous conditions, which rendered good results hopeless from the first.

In conclusion, it only remains to point out that the cataract coucher, however excellent his intentions, is a standing menace to the people among whom he practises. There is an urgent call to the Governments of Eastern countries to plan and to effect his overthrow in a deliberate manner, by the systematic dissemination of information on the subject among the people by means of suitable agents, and by taking a much wider view of their responsibilities for ophthalmic relief than many of them have done heretofore.

Those who are interested in the subject will find it dealt with, at much greater length, in the author's work [1] to which reference has already been made.

[1] *The Indian Operation of Couching for Cataract*, by R. H. Elliot. H. K. Lewis & Co. Ltd., London, 1917.

CHAPTER V

PATHOLOGY

THE coucher may displace the lens in any direction within the sclero-corneal coat, but backward dislocations are at least thirteen times as common as forward ones.

FIG. 47.—Left Eye, temporal half. A small dark Morgagnian nucleus lies impacted in the lower angle of the anterior chamber, which is filled with coagulated exudate.

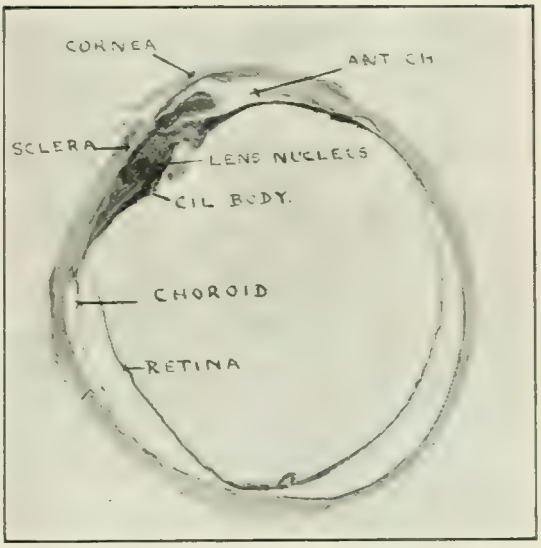

FIG. 48.—A thin section of a Couched Eye. Lens dislocated between ciliary body and sclera; the pectinate ligament had been ruptured at the operation.

Forward Dislocations (Figs. 47 and 48). — The whole lens or its nucleus, or the nucleus with some cortex, may be found in the anterior chamber, or in the subchoroidal space, having reached the latter situation through a rupture in the pectinate ligament. In any of these positions there is a strong tendency for the mass to become sealed in place by inflammatory exudate. Rarely, however, a nucleus of a Morgagnian cataract will be found to pass freely through

the pupil from the anterior chamber into the vitreous cavity and back again.

Backward Dislocations (Figs. 49 to 52). — Very wide variations are found both in the completeness and in the direction of the displacement. Thus (1) the cataract may be completely dislocated into the vitreous and may lie floating freely therein (Fig. 49); (2) it may be entangled in a more or less consistent inflammatory exudate which occupies the vitreous chamber, its movements being limited thereby; (3) it may be firmly fixed to the ciliary body, and to the back of the iris, by definitely organised fibrous tissue (Fig. 50); (4) it may lie matted between the iris and ciliary body in front and the completely detached retina behind, the whole forming one continuous mass of blurred exudative tissue (Fig. 51); (5) though dislocated backward, it may lie distinctly in front of the hyaloid membrane, and therefore outside of the vitreous body (Fig. 52); and (6) it may, though very rarely, be found thrust through and behind the retina.

Accidental Injuries to other Structures than the Lens during Couching.—Opaque scars are often seen on the cornea, and a fistula of that membrane may rarely be present. Similarly, scars of the sclera, not infrequently pigmented, may show where the wound was inflicted. The underlying uveal tissue is often entangled in the depth of these cicatrices, and rarely a filtering scar may be left as a result of the original stab. Tears or scars in the iris, the ciliary body, and the choroid are common. Some form of uveitis is the rule rather than the exception; it is plastic in type, and is mostly confined to the iris and ciliary body, but all grades of inflammation occur, from the very mild and local to the acutely septic, which latter terminate in panophthalmitis.

The Chambers of the Eye.—The *anterior chamber* may be empty owing to a fistula of the cornea, or it may contain pus, blood, lens matter, albuminous exudates or semi-fluid vitreous. The *vitreous body* is frequently infiltrated with inflammatory material, as the result of the implantation therein of septic substances which give rise to a defensive,

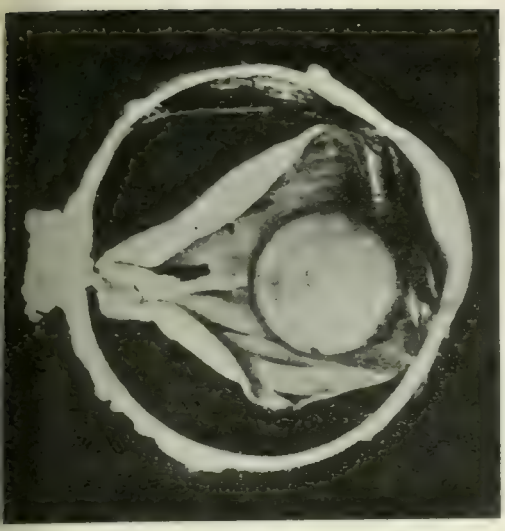

FIG. 49.—Right Eye, lower half. A large Morgagnian Cataract floated free in the vitreous chamber. The retina is totally detached.

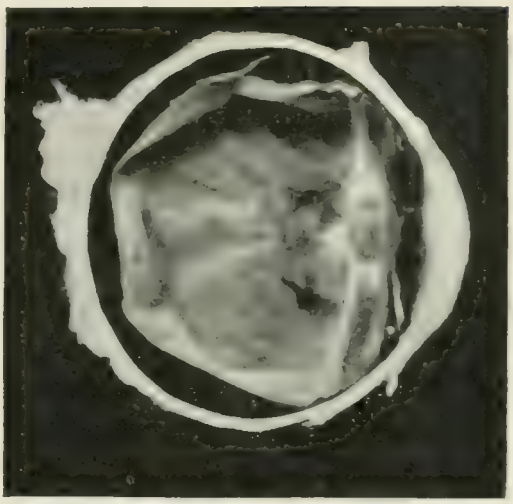

FIG. 50.—Right Eye, lower half. Lens dislocated downward, and tightly bound to the back of the iris and ciliary body by organised exudate.

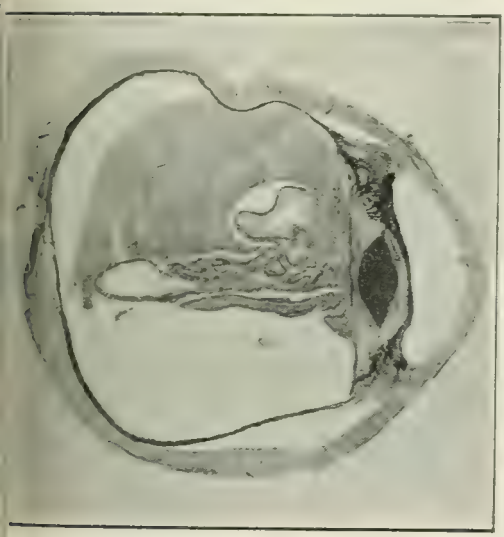

FIG. 51.—A section of a Couched Eye, showing the retina totally detached and rolled up into cysts. The lens is embedded in inflammatory exudate; there is great matting of the parts; the eye is shrinking.

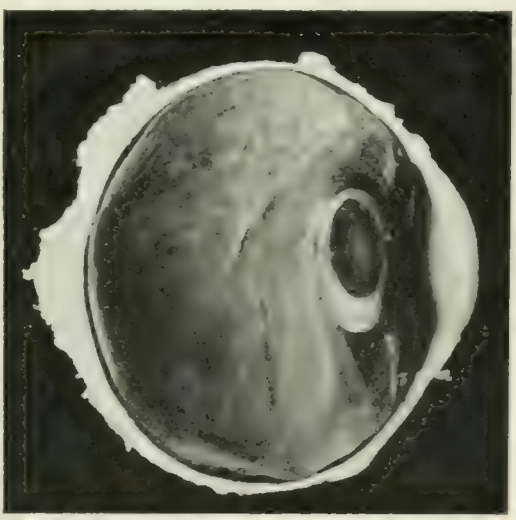

FIG. 52.—Left Eye, lower half. A hard dark nuclear cataract had been depressed; it lies in front of the unruptured anterior hyaloid membrane, and therefore *outside* the vitreous cavity.

chemotaxic action originating from the surrounding vascular structures. The *retina* shares in the inflammatory action thus produced. *Choroiditis* is rare, and evidence of the type of uveitis associated with *sympathetic ophthalmia* is conspicuous by its absence from the pathological material which has been examined. Apart from any inflammatory change, the pigmentary layer of the retina is irregularly thinned and altered, and at some points its pigment can be seen migrating into the choroid ; as for the choroidal pigment, it too is extensively altered in an irregular manner, being heaped up in some areas and thinned in others. These latter changes are to be attributed to the metabolic processes, associated with the development of cataract, and not in any way to the operation.

Evidence of **glaucoma** is very frequently met with in the pathological specimens, and in the great majority of cases the angle of the anterior chamber is found to be extensively closed. Other phenomena are met with which would explain the rise in tension, *e.g.*, anterior synechia, capsulo-corneal synechia, retino-corneal synechia, involvment of the ciliary body in the scar, tilting of an incompletely dislocated lens, and irido-cyclitis and its sequelæ.

REFERENCE

Elliot, R. H.—*The Indian Operation of Couching for Cataract*, H. K. Lewis & Co. Ltd., 1917 ; and The Hunterian Lectures delivered before the Royal College of Surgeons of England, on February 19 and 21, 1917 ; and *Brit. Journ. Ophth.*, February 1919.

CHAPTER VI

DIAGNOSIS

The diagnosis of a case of couched cataract presents the surgeon with three distinct problems—(1) To ascertain whether a couching has been done or not ; (2) to discover the new position of the lens and its condition ; and (3) to decide whether it is advisable to operate.

It might be thought that the simple and obvious way to ascertain whether a couching had been done would be to ask the patient or his relatives. In a large number of cases this is, of course, sufficient ; but many Orientals will deny the operation they have undergone. This is due to the fact that it is widely known among the people that the British surgeons view the coucher and all his methods with extreme disfavour. Patients are therefore reluctant to admit having consulted him, and they are also afraid lest treatment should be refused them, once their true history is known ; for it is common knowledge amongst them that the Western practitioner is extremely reluctant to interfere with an eye which a coucher has spoilt.

We will first consider the case of those eyes in which **the cataract has been definitely removed from the neighbourhood of the pupil**. These present certain well-marked signs—(1) *The pupil is brilliantly black*, and (2) *the plane of the iris is flat*. These features are so obvious that a diagnosis can often be made as soon as the patient takes his seat in front of the surgeon. The quality of the blackness of the pupil is difficult to put into words, but it arrests the attention by its contrast to the ordinary appearance of the pupil in people so advanced in life as the subjects of cataract usually are. The phenomenon is due to the whole cataract, capsule and all, being thrust away from the

pupillary area, and it can be equally well seen in cases which have undergone the intra-capsular operation. Then, with regard to the flattening of the iris, the trained eye is used to the appearance presented by the slight forward convexity of that membrane, as a result of the presence of the lens behind it; whereas the complete removal, not merely of the lens, but also of the support of the suspensory ligament, makes the iris flatten out in its own plane.

On close inspection we notice other signs. (3) *The iris*, deprived of the support of the lens, *is often tremulous*. This can best be observed if the patient is bidden to move his eye sharply in different directions. (4) *Scars* may be seen *on the iris*. These are the result of tears of the membrane during the operation. In some cases they are associated with an irregularity of the pupil which may be extreme, or with a limitation or absence of pupillary movements. In other cases the immobility of the pupil, which may be absolute, is associated with (5) *an atrophic condition of the inner free margin of the iris*. Such a condition is only met with in very long-standing cases. Transillumination of the eye will sometimes show up the scars, or the atrophic condition just referred to, as light spaces against the rest of the dark background of the iris. (6) A careful study of the cornea, or of the sclera in its neighbourhood, will often reveal *evidence of the wound made by the instrument* during couching. In the cornea these usually take the form of small nebulæ or leucomata, lying just within the limbus, and usually in the temporal quadrant. Scars in the sclera are much more difficult to distinguish, but they can sometimes be detected by the pigmentation which overlies them. (7) We come now to the leading feature in the diagnosis of these cases—namely, *the recognition of the displaced cataract in its new position* within the eye. In the rare event of a lens being dislocated into the anterior chamber and fixed there, its presence can be easily recognised. Again, in a large number of the cases which present themselves in the out-patient room, the cataract can be seen floating freely in the vitreous, and bobbing up and down with the movements of the eye. In the case of the

milky Morgagnian cataracts, or of those cortico-nuclear cataracts which present a glistening and pearly-sectored appearance, it would be difficult even for a beginner to fail to see the lens, which usually lies at the lowest part of the eye. As the patient sits in front of the surgeon, the gleam of the white cataract can be caught each time he looks downward, even though a distance of two or three feet may separate him from the observer. In the case of darker cataracts, such as the pigmented nuclear ones, frequently met with in Indian practice, a closer examination is required.

The patient must be brought near to the observer, and facing a good source of illumination. The surgeon then focusses the light on the pupil by the aid of a lens, bidding the patient at the same time to look downwards. If this fails, the patient is instructed to bend his head forward, holding the face horizontal ; the surgeon then places one closed fist on the back of his head, and gives a number of sharp raps on it with his other fist ; when this is done, it is often found that the lens has gravitated down on to the pupil. If the patient's head be now quietly raised, the lens can be seen dropping gently away from the pupil, which turns from white or brown (according to the nature of the cataract) to black as it does so. The experiment can be repeated again and again. Sometimes the lens falls away from the pupil so quickly, that the surgeon must stoop down and look up at the eye in order to see it. If even after this test he fails to see the cataract, it is safe to assume that it is tied down in its new position by inflammatory adhesions, excited by the septic matter introduced at the time of operation. The dilatation of the pupil by a mydriatic will often make it quite easy to discover the whereabouts of the cataract, especially if a strong light, whether natural or artificial, is focussed on the eye by means of a lens. Natural light is preferable to artificial if possible, especially in a country like India, where powerful daylight can be counted on during a large part of the year. The advantage of the white light is especially marked when dealing with brown or dark-coloured cataracts. An examination with

the opthalmoscope or with a transilluminator may sometimes be of value, but in the class of cases we are now discussing, these are seldom of much use, if the examination just described fails to reveal the whereabouts of the cataract.

There remain a few points of interest which deserve mention. Though in the great majority of couched eyes the cataract lies in the lowest part of the globe, it may be found either to the inner or to the outer side, or even in the upper half of the eye. Sometimes it flaps backward and forward with the movements of the globe, swinging on a hinge, which evidently consists of the remaining fibres of the suspensory ligament, and which may be situate in any possible direction, though most often it lies below.

Our next consideration is that of **the cases in which the cataract still lies behind the pupil.** It then seldom, if ever, is in absolutely normal position, and it very frequently is found to have been moved bodily downwards, or to one side, or obliquely. Again, but more rarely, it may be tilted backward at an angle with the plane of its normal position. In a great number of cases the history will help one, and, even when the patient denies couching, he will very often admit to having had "medicine applied to his eye by a native practitioner." Should no such evidence be forthcoming, there may still remain that of the lesions to the cornea, the sclera, or the iris, to which attention has already been directed in the previous paragraphs.

From these cases we pass on to consider **those in which the lens cannot be seen at all, owing to the occlusion of the pupil.** Here our difficulties are greater still, and, if the history fails us, we must fall back on a careful search for signs of wound scars in the cornea or sclera, or of tears in the iris. A point which is always suggestive is the existence of a cataract in the opposite eye. In such cases as these, the contents of the chamber may be found to consist of pus or of blood.

Our next group is a still more difficult one, for in it **no fundus reflex can be obtained.** It embraces a number of conditions which may be shortly dealt with in turn—

(1) Those in which the vitreous body has been converted into a more or less highly organised inflammatory exudate, which is impenetrable to the light of the opthalmoscope. (2) Those in which this vitreous exudate has contracted inflammatory adhesions to the retina, and by its shrinkage has determined the total detachment of that membrane. (3) Those in which the vitreous chamber has become filled with blood. It is obvious that in all such cases our main dependence must be upon the history, though the other indications already outlined may help us in some of them.

Lastly, there are the **cases in which the eye is undergoing shrinkage,** and those in which **phthisis bulbi** is following panophthalmitis. The history of the signs and symptoms of severe irido-cyclitis or of suppuration will, in India at least, always excite a suspicion of couching having been performed, unless the patient has a definite story to tell us of some other form of injury. Strangely enough, the inventive faculty of the Indian patient does not rise to the height of vamping a narrative of the kind. If he has had an injury, he tells of it readily. If he has been couched, he stolidly denies that anything occurred to cause his trouble, which he states "simply came of itself."

It will be observed that in the preceding remarks we have dealt with two of the problems which confront us in diagnosis, for the simple reason that it is very difficult to separate them; to do so would mean needless repetition. The discovery of the new position of the lens, and of the degree of fixation, if any, it has undergone, can hardly be divorced from the question of whether a couching has or has not been performed. Our third problem is to decide whether it is advisable to operate in any cases, and if so, in which.

If we look at the question simply from the surgical point of view, there can be no doubt that to attempt the extraction of a couched lens is both a difficult and a dangerous procedure, since there is always present the risk of lighting up a septic explosion, the real responsibility for which lies with the original operation. There is, however, another and an even more important standpoint from which we must

regard the question; for, if the operation fails, Western surgery will certainly be saddled with the discredit, which is justly due to the filthy and unscientific methods of the coucher. The motto of every surgeon, work where he may, is ever—"The greatest good of the greatest number." Failure in such cases as these may play into the hands of the coucher, and enable him to extend his sphere of influence at the expense of the beneficent work of the Western hospitals. The problem in the East is a difficult one, in which surgical considerations do not stand alone, but are interwoven with social, moral, and even political questions. Each surgeon must decide for himself what line he will take, and must then follow it fearlessly and consistently.

There is, however, one point on which the author is quite clear. The extraction of a couched cataract should only be undertaken if the lens is freely movable, and never when it is tied down, as it so often is, by inflammatory adhesions. The most favourable cases for operation are those in which good vision is interfered with, owing to the cataract being incompletely dislocated, and consequently flapping across the pupil. Such patients complain that, although in certain positions they can see excellently, the sight is blocked, either intermittently or constantly, by the tendency of the lens to return to its position behind the pupil. The relief given by operation may then be very great and very highly appreciated.

CHAPTER VII

CLINICAL

A FEW points of great interest remain to be shortly noticed.

Pain.—A striking feature of the evidence given by patients, who have undergone the operation of couching, is the extraordinary difference in the amount of pain inflicted at the time. Some make very light of it, others complain bitterly of the physical agony inflicted, whilst the majority, though admitting that they were hurt, do not appear to have very lively recollections of their suffering. The same is true of the experience of the next twenty-four hours. When, however, irido-cyclitis sets in, as is so often the case, we hear regularly of severe and long-continued pain.

A Comparison of Depression and Reclination.—There can be no question that the operation of reclination breaks up the vitreous body to a considerably greater extent than mere depression of the cataract does. On the other hand, the claim is made that after its performance the lens is much less likely to undergo reascension ; indeed, it was for this reason that Willburg introduced the method ; and, if we may judge from the evidence of later writers, he was justified by results. So far as the Indian coucher is concerned, it seems a little doubtful whether he has any clear conception of the difference between the two procedures ; indeed, so long as he gets the lens out of the way of the pupil, it is probable that he neither knows nor cares which method he has succeeded in adopting, though he probably much more often reclines than depresses. This latter fact may be explained by the experience of a number of European surgeons, that it is more easy to effect reclination than depression.

Reascension of Couched Cataract.—This was a topic which attracted a good deal of attention from the early writers, who commented on its relative frequency immediately after the operation, and gave elaborate instructions to prevent its occurrence. Some of them went so far as to suggest the frequent repetition of the operation, if necessary. In their experience it would appear that, if reascension failed to occur within the first fortnight, the prospect of the lens remaining down was good. Nevertheless, they were familiar with the fact that, even after years of a happy result, the cataract might suddenly be found to have returned to its old position opposite the pupil. In some cases this misfortune followed a blow or fall on the head, or a severe jar of the whole body. Similar stories may be heard in an Indian out-patient room to-day. This is a point which must be taken well into consideration by any, who think fit to resort to couching in selected cases.

A Comparison of the Corneal and Scleral Routes for Operation.—It has been already shown that the Indian operators of the present day vary in their technique, some attacking the lens from in front, through the cornea, and others from behind, through the sclera. It is interesting to note that there is a similar difference in practice amongst those of the modern surgeons who have adopted couching in special cases. There can, however, be no doubt that the weight of opinion among the old writers was all in favour of the posterior operation.

The Dislocation of Morgagnian Cataracts.—A curious error is to be found pervading many of the writers on couching—namely, that a Morgagnian cataract cannot be couched in its capsule. Hospital experience in India has proved that this idea is erroneous, and the examination of pathological specimens has shown the correctness of the clinical deductions. The Morgagnian lens may be dislocated forward into the anterior chamber, or backward into the vitreous, or even through the coats of the retina, without rupture of its capsule. This is far from being a surprise to any surgeon who has operated on a number of these cases, for the Morgagnian capsule is usually very much tougher

than that of any other form of cataract. It has already been mentioned that, if the capsule bursts, the nucleus may escape, and may then sometimes be found, either floating freely in one of the chambers of the eye, or fixed in one position by inflammatory adhesions, or, still more rarely, passing from chamber to chamber at intervals. The writer has observed that in some cases the escape of Morgagnian fluid into an eye appears to cause great irritation. The same fact has been observed by some of the early writers on couching.

SECTION VII

CATARACT EXTRACTION

Introductory.

Chapter I. The Selection of Cases for Operation.

,, II. The Preparation of the Patient for Operation.

,, III. Asepsis, Antisepsis, and General Arrangements.

,, IV. Methods of Operating for Cataract.

,, V. The Madras Cataract Operation (By Lieut.-Col. H. Kirkpatrick).

,, VI. Warnings and Rules.

,, VII. The After-Treatment of Cataract Operation Cases.

,, VIII. The Frequency of Cataract in Tropical Countries.

INTRODUCTORY

It would be outside the scope of the present work to attempt to write an exhaustive treatise on cataract. The aim the author has set before him has been to help the man who is beginning ophthalmic work in the East. With that end in view, attention has been confined to severely practical details, and the whole subject has been dealt with in a manner somewhat different from that of the ordinary textbook.

It has been the author's privilege to teach a large number of surgeons to operate for cataract on the living eye, and he has formed very definite opinions as to the best course for the beginner to follow. His teaching must, therefore, necessarily be dogmatic. This does not imply that there is not another side to many of the questions dealt with in the following pages ; of course there is.

Once the beginner is firmly grounded, and is practically conversant with the details of a sound method of procedure, he will gather experience and formulate rules of his own ; for the man who is not an individualist in cataract extraction, is original in nothing.

The author received no help himself, and was left to flounder through difficulties in order to reach the firm ground of knowledge based on experience. This was bitter to him, and hard on his early patients. His practice ever since has consistently been to try and save others from the difficulties and disappointments that surrounded his first efforts. It is in pursuit of that aim that this section has been written.

CHAPTER I

THE SELECTION OF CASES FOR OPERATION

The beginner must take no risks in a new district in India, for, if his early cases are not crowned with success, he will certainly have an uphill fight to win a good name with the people ; on the other hand, the fame of a few successes at the commencement will go far to establish him in the confidence of the neighbouring blind. Later on, he may take the patients as they come, and do his best for all alike ; but he will be well advised to be careful in the selection of his earlier operation cases, and to thereby make success as assured as possible. Patients should therefore be chosen who fulfil the following conditions—(1) The cataract must be mature ; (2) it should be of an easily removable type ; (3) the eye must be free from all dangerous complications ; (4) the subject must be quiet and tractable ; (5) there must be evidence that the functions of the retina are not impaired ; (6) obvious sources of auto-intoxication must be absent.

We may take up these points in the above order.

1. The absence of an iris shadow constitutes the beginner's best test of the maturity of a cataract. If the lens is cataractous right up to its surface, the iris will lie in direct contact with opaque lens matter, and no shadow can be cast by the iris on to the lens, for the two are practically in the same plane. Just in the same way a man, lying on the earth in sunlight, throws no visible shadow. If, on the other hand, there is a layer of clear lens matter between the iris and the opaque portion of the lens, an iris shadow is at once seen, cast through the clear layer on the deep-lying opaque portion (Fig. 53). The best way of judging of the presence of an iris shadow is by focussing

a good light obliquely on to the edge of the iris by means of a plus 16 D lens ; the appearance is then unmistakable.

2. The easiest type of lens for removal is also fortunately a fairly common one ; it may be called the "pearly sectored lens." The more marked the sectoring appears, and the more glistening the pearly appearance is, the easier will the removal of the lens prove ; for these characters foreshadow favourable conditions for operation, inasmuch as such lenses consist of a central, and not very hard or large nucleus, surrounded by a quantity of soft diffluent

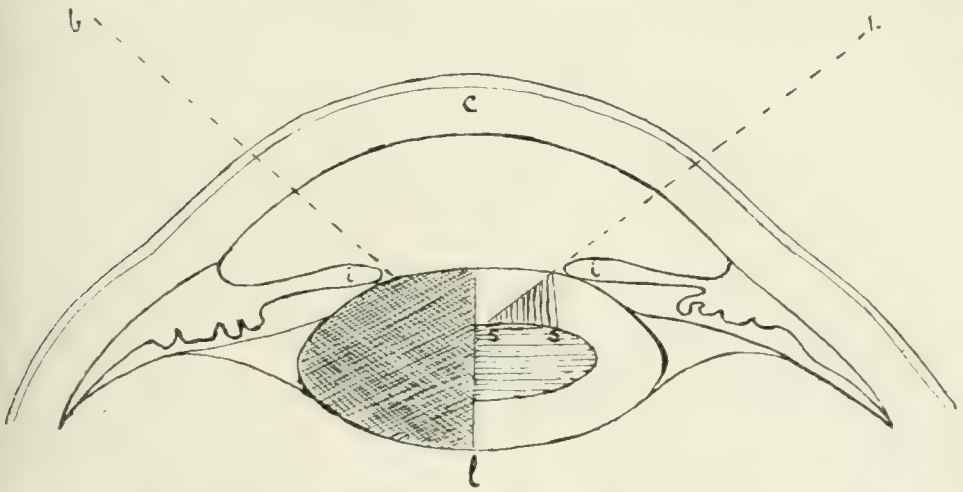

FIG. 53.—To explain the formation of an iris shadow : On the left side the lens is opaque right up to its capsule ; consequently the iris casts no shadow. On the right side, the centre of the lens is opaque, and its periphery clear ; consequently a shadow of the iris is cast by the beam of light, through the clear cortex, on to the opaque nucleus. *c*, cornea ; *i*, iris ; *l*, lens ; *bb*, beams of light ; *ss*, iris shadow.

cortex. Next in order one may place the Morgagnian lens, for if preliminary needling is done, this kind of lens loses its thick fluid, and the chamber being deepened thereby, the passage of the knife during section is rendered easy. Next we find the pale opaque lens with distinct radial marks on its surface. The more uniform and the denser the opacity, the easier will extraction prove. The only difficulty that will arise, will be in connection with the removal of the doughy edges such cataracts tend to leave behind them after the nucleus has escaped. Low down in the order of choice should be placed the hard nuclear catar-

acts known by their brown coloration, by their absence of markings, and by their occurrence in patients of advanced age. Lower still should come the "black cataracts," with their coal-black reflex and their characteristic metallic sheen; for they are often associated with some defect or defects in the receiving apparatus of the eye, and even the best surgical result may then be attended by a failure to improve the patient's vision. Last of all, and to be avoided by the tyro, comes the big class of immature cataracts, with their peripheral cortex varying from clear to ground glass in appearance, for interference with these will involve the leaving behind of cortex, and subsequent trouble to the surgeon as well as to the patient.

3. The conjunctiva must be healthy, or if not, it must be brought into a sound state before operation is attempted. The lachrymal passages must be healthy and pervious; a drop of fluorescin or of argyrol solution instilled into the conjunctival sac will speedily appear on a pledget of wool held to the nostrils, if the patient blows strongly through the nose, provided that the tear canal is healthy and pervious. Posterior synechiæ, and the presence of glaucoma are both dangerous complications. Corneæ which bear marks of old-standing mischief are best left alone by the beginner. Patients in a low state of health are bad subjects for any operation; failure of union, or worse, may be feared in such people.

4. Much depends on the patient. An operation, which is easy in a quiet, tractable man, may be difficult, if not impossible, in one who is destitute of self-control. It is hard for anyone who has not had experience of natives to understand how frightened such patients may become. The terrified ones shut up their intellects like an oyster does its shell, and no words of the operator or of his assistant can be got to reach them; they will do nothing they are told, for they *do not hear* what is said to them. Sense seems paralysed by fright. The young operator who starts on such a subject may be greatly discouraged, and he is certainly not likely to make a success of the operation. These patients can often be recognised beforehand. When

under examination they will not look down, and they squeeze their lids instead of opening the eye. There is one sign of great value, consisting in a peculiar facial expression, which strongly suggests the angry grimace made by a frightened monkey. The corners of the mouth are drawn down squarely, and the chin is wrinkled, whilst the nose appears to be drawn upwards. The surgeon, who is not absolutely sure of his manipulative dexterity, will do well to refuse such cases, or else to operate on them, only after the administration of a liberal hypodermic dose of morphine. Many native patients, who are quite intractable when they first come on the table, will lie quiet and suffer the operation without a murmur if the surgeon deals sharply and firmly with them.

5. When due allowance has been made for the density of the cataract present, there should be a *reasonable degree of visual acuity* left. A patient should be able to detect hand-movements through even the most opaque cataract, whilst many people with mature nuclear cataracts can readily count fingers. Should the amount of vision found be below what might reasonably be expected under the conditions present, it is safe to assume that the case is complicated by the existence of fundus changes, which, even after a successful extraction, will account for a poor visual result, disappointing to the patient and damaging to the reputation of the surgeon. In any case where the surgeon is in doubt, the subject should be taken into a dark room and tested with a candle or other source of illumination, to find if he can distinguish the direction of the light as it is moved around in his peripheral field. This is spoken of as testing the field of projection of light. If projection is good, it is usually worth operating, even though the attainment of good central vision may be doubtful; but the man with a name to make in a fresh place will be well advised to leave doubtful cases alone.

6. To operate for cataract on a patient with pronounced dental sepsis, with nasal or aural suppuration, or with any other form of obvious auto-intoxication, is to give hostages

to fortune. Later on the surgeon may have to take such risks, but at his beginnings he will be wise to avoid them.

A word in conclusion: The surgeon in the Tropics must select his own cases, and not leave the work to an assistant. It is most essential that he should come into personal touch with the people among whom he works, and win their confidence by sympathy, patience, and daily contact with them. He must talk their language, or languages, and must always have the time to spare to listen to their wants and grievances. When his work gets too big for one man to do, he is bound to organise his hospital accordingly, and to depute much of the work to others; but he should still keep in touch with every department of the work, and be a living, moving presence with which his patients are daily familiar. He will be more than repaid in their confidence and trust, and in that success in numbers which the East so freely brings to the Western surgeon, who knows how to tap rightly its immense resources of clinical material.

CHAPTER II

THE PREPARATION OF THE PATIENT FOR OPERATION

In tropical countries, where dirt and sepsis are rife, it is most important that the patient should be very carefully prepared for operation. Owing to the large numbers involved, organisation and the adoption of a strict routine are necessary, and the more so, since the staff of helpers is usually composed of men and women, whose educational qualifications are very low.

One day in the week should be set apart for cataract extraction. If the numbers be not too large, other major eye operations can be performed at the same sitting. It is well for the surgeon to make inquiries as to "lucky" days and hours before settling his schedule of work, as in many parts great stress is laid on such matters, and it is far better that the patient should enter on the post-operative period with the confidence that an observance of such superstitions engenders, rather than that he should lie tormented with fears during this anxious time. The following simple rules, modelled on the procedure adopted at the Madras Ophthalmic Hospital, are suggested for the guidance of those who work in tropical countries—(1) Admit the patient at least two clear days before operation, and see to it that he is washed and purged. (2) Have the eye carefully inspected in the early morning of the day after admission, and before he has washed his face, in order to make sure that there is no dried secretion around the lid aperture. If such discharge is found, put him back for further treatment of the conjunctiva. (3) On the evening before operation (or if time admits of it, on the morning of the operation), have the temporal lashes of

the upper lid cut close with scissors, whose blades have been smeared with sterilised vaseline; the object of the lubricant is to catch the hairs and so prevent them entering the conjunctival sac. Wash the skin around the orbit with soap and boiled water. Flush out the conjunctival sac freely with cool, normal saline solution. (4) On the morning of operation, and about an hour before the patient comes on the table, instil a drop of 1 per cent. atropin solution into the conjunctival sac, and be careful to close the canaliculi, by finger pressure, for a full minute afterwards, in order to prevent the fluid passing down into the nose. This is important, as in India, at least, quite a large percentage of the patients will be found to suffer from atropism, if this precaution is neglected. (5) The sterilisation of the conjunctiva must next be taken in hand, and the surgeon's success or failure will depend very largely indeed on the care he devotes to this matter. In a land where post-operative, ocular sepsis is rife, he may practically banish it from his hospital by the systematic use of perchloride irrigation. Fifteen minutes before the commencement of the operation, the lids should be everted and flushed for 2 or 3 minutes with a stream of perchloride lotion (1 in 3000). Four instillations of a 4 per cent. solution of cocaine should be made at 2 minute intervals; after the second of these, a subconjunctival injection should be given of a solution of cocaine and adrenalin. For this purpose, 1 drop of a 4 per cent. solution of cocaine hydrochlorate is taken, together with 1 drop of 1 in 1000 liq. adr. chl. (P. D. & Co.), and 2 drops of normal saline solution for each eye to be anæsthetised. The operator now swabs out the conjunctival sac to its farthest recesses by means of sterilised cotton-wool sponges mounted on sticks, whilst the assistant freely flushes the area with a stream of normal saline solution. The retained Meibomian secretion is expressed by firmly squeezing the edges of the lids between the finger and thumb, whilst the free edges of the lids are scrubbed with a mounted dry wool sponge. (6) The skin of the eyelids and of the side of the face should be sterilised by free painting with tincture of iodine;

the free edges of the lids, and especially their hair-bearing border, should also be painted, taking care that no iodine enters the eye. Many surgeons have an unreasoning fear of the results that may follow the entry of this drug into the conjunctival sac, even in small quantities, but such apprehensions are without any foundation. It is unpleasant for the patient, but no real harm is done. (7) The hypodermic injection of a 0·25 c.c. of trivalin hyoscin is of great value in all major eye operations, and especially when dealing with nervous patients. It should be given a quarter of an hour before the extraction ; it produces a quieting effect, relieving the patient's anxiety and making the operation much easier. It also greatly lessens the pain and discomfort of the first 12 hours, and so tides us over the worst period of the case. The Saccharin Corporation, whose product it is, have had it specially put up in 0·25 c.c. ampules.

CHAPTER III

ASEPSIS, ANTISEPSIS, AND GENERAL ARRANGEMENTS

The Sterilisation of Accessories.—All *dressings*, cotton-wool *swabs*, *bandages*, etc., should be sterilised by steam-heat, and kept in drums up to the moment of use. If this is not possible, the dressings should be wrung out in bi-cyanide solution; but the use of antiseptics is decidedly inferior to the establishment of asepsis. In any case, the surgeon must bear in mind that the risks of infection are very much greater in tropical countries than they are in Europe. A ward attendant, with very poor educational qualifications, can often be trained to do excellent routine work as an assistant in such matters.

Dropper bottles.—All rubber goods are apt to perish in hot climates, and for this reason the all-glass drop-bottle is to be preferred. To ensure sterility, the author has devised a small cruet (Fig. 54) with a gauze floor, on which the bottles stand during boiling, so that they are not upset by the ebullition of the fluid. The ring-handle of the cruet enables the device to be removed from its boiling-case for cooling. After the operation the cruet can be replaced in the case, which is first emptied of water; in this way the bottles can be kept sterile for use at each successive dressing. It is essential to impress on native assistants that they must avoid contaminating the rims of the bottles by contact with dust, with their hands, or with any doubtfully sterile surface. If they are to instil the drops, as they often must for want of any other form of available help, they must be deliberately drilled in

details. Once taught, they will do excellently, provided that all supervision is not withdrawn.

For the purpose of sponging out eye-wounds, it is of great advantage to use *mounted swabs.* The practice, so prevalent in Europe, of using small wool sponges held in the hand, stands self-condemned anywhere, and obtains no sanction from its adoption by any surgeon, however famous. In the East, it is, if possible, still more indefensible. The midribs of the leaves of the palmyra, or of other palms, furnish excellent handles for eye-swabs. These small sticks are used extensively throughout the East for making sweepers' brooms. They are very tough ;

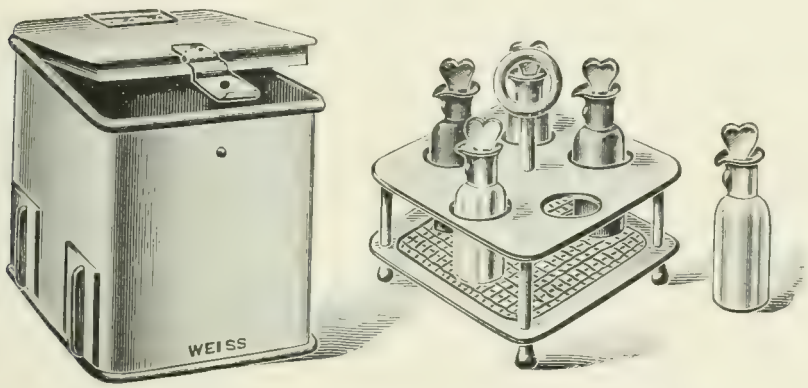

Fig. 54.—Author's Cruet, for the sterilisation of drops used during operation.

they can be boiled or soaked for long periods in strong antiseptic solutions ; they last for years ; and their cost is so low that a hospital can be stocked for a year for a couple of pence or less. By their use the assistant's hand is kept well away from the wound, and, at the same time, out of the operator's line of sight.

The Irrigation of the Eye before Operation is even more essential in hot and dusty countries than it is in Europe. A good free flow of sterile fluid is required for the purpose ; it is important to prevent any of this running into the ear, in order to avoid upsetting the patient unnecessarily ; there are nervy people who will make more fuss over water in their ears than over the operation itself.

The teapot-shaped irrigator (Fig. 55) and the author's tray (Fig. 56) are of great assistance in this manœuvre. The former can be filled with saline, and sterilised on a gas ring beforehand; the latter is so constructed that, if properly used, not a drop of fluid can escape it.

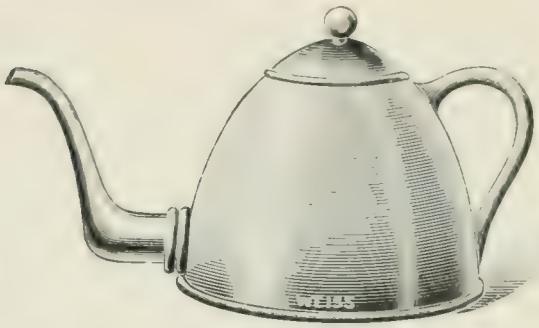

Fig. 55.—Author's Teapot Irrigator for washing out conjunctival sac. It can be sterilised by boiling on a gas-ring.

The Sterilisation of McKeown's Irrigator.—When a large number of cataracts are to be operated on in a single morning, this valuable apparatus will be found easy to sterilise and absolutely safe to use. The directions for its preparation are as follows: Detach the rubber bellows from the tube D, raise the glass tube B, as shown in Fig. 57, and arrange the rubber tubing R attached to it, so that the end hangs free and is not in contact with any surface; the bottle should have been filled two-thirds full with normal saline solution, and is now ready for boiling. After free ebullition, and immediately after removal of the flask from the flame, clamp the rubber tube R, and dip its free end into a bottle filled with sterilised normal saline solution till the apparatus is to be used; lower the tube B to its usual place (Fig. 58); cool air now enters, but it can only do so through the tube D, the bulb of which is filled with asbestos wool. When one is about to operate, the bellows are attached at D (Fig. 58), and a freshly-

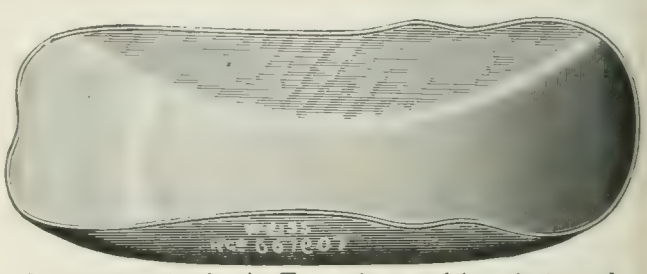

Fig. 56.—Author's Tray for catching irrigated fluid. It has been moulded in order to fit practically any face when properly adjusted, so that the indentation adapts itself to the zygoma. Its right and left sides enable it to be used on both sides.

boiled cannula is adapted to the tube R; the clamp C is relaxed and the irrigator is ready for work. It is absolutely necessary to have the fluid carefully filtered before it is boiled.

If only a few cases are to be operated on in a morning, the surgeon may adopt a simpler but still efficient form of irrigator. This consists of the barrel of an ordinary 2-ounce urethral syringe, to the nozzle end of which is securely fastened one end of a piece of fine india-rubber tubing, 3 feet in length, whilst the opposite end of the tubing carries a McKeown's irrigator nozzle. The whole apparatus is boiled for 5 minutes before use, and is then emptied and filled with normal saline solution (0·8 per cent.). A separate assistant takes charge of the

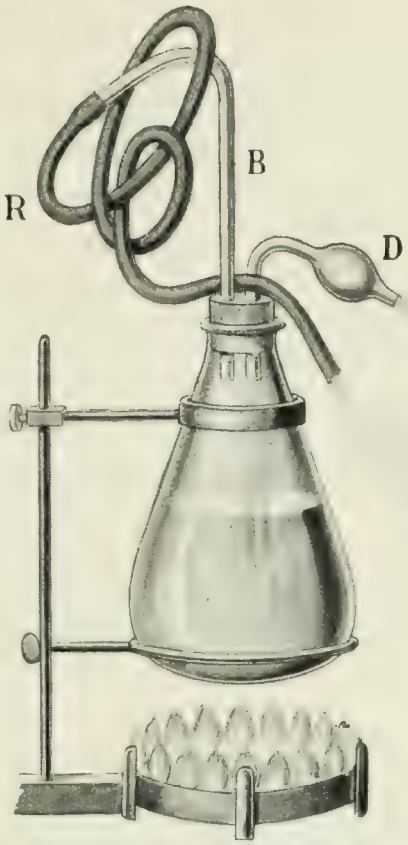

FIG. 57.—McKeown's Irrigator, during sterilisation.

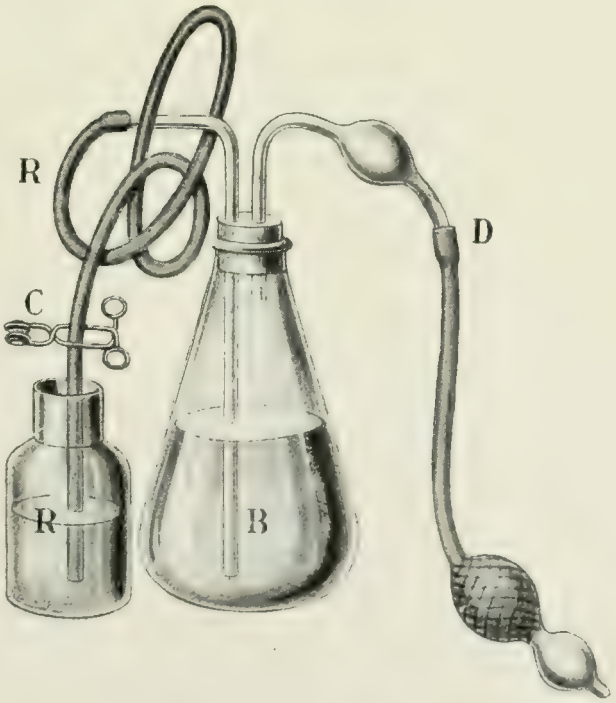

FIG. 58.—McKeown's Irrigator, ready for use.

apparatus, and gives the nozzle into the surgeon's hand when he is ready to use it.

The Sterilisation of Cutting Instruments.—In the Madras Eye Hospital all cutting instruments are boiled in rain-water to which a pinch of bicarbonate of soda is added, to prevent rusting. The rain is collected from the hospital roofs during the monsoon, and stored in large, glazed, earthenware jars, which are tightly closed up until required. The plan adopted is to allow a heavy shower to cleanse the roofs, and then to collect the water straight into the jars. It was

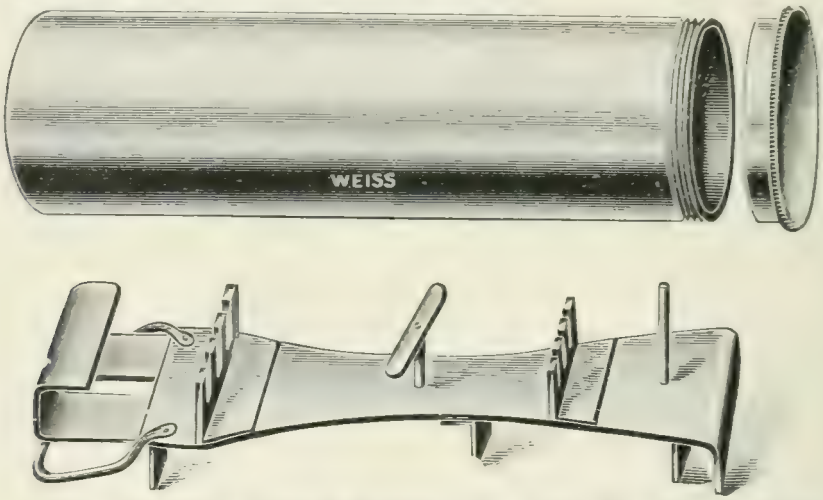

FIG. 59.—The Alcohol Steriliser to carry the cutting instruments for a cataract operation. The tray shown below carries the knives and needles above, and the scissors below. The loaded tray fits into the tube shown above, which is filled with alcohol, and tightly closed by the screw and a rubber washer in the lid.

found that instruments could be repeatedly boiled in this rain-water without their edges suffering perceptibly. One knife, for instance, might be used 40 or more times without losing its edge, although it was boiled afresh after each operation. All attempts to substitute distilled for rain-water have, in the author's experience, failed dismally. A single boiling in the former fluid will often suffice to spoil the cutting edge of a knife, even before it has been used at all. If a good and clean supply of rain-water is not available, it is better to sterilise the cutting instruments with absolute alcohol: and for convenience in using this fluid, cases have been made to carry the necessary instruments (Fig. 59). When em-

ploying this latter method, the surgeon can rely confidently on sharp-cutting edges. It is hardly necessary to add that all non-cutting instruments are best, and most cheaply sterilised by boiling. No instrument should be inserted a second time into the eye without reboiling.

The Surgeon's Hands.—In Eastern practice, where very large numbers are often dealt with (30, 40, 50, or even more cataracts being extracted in a single morning), the hands should be well washed before each operation, but no strong antiseptics should be used. In this way the delicacy of touch is preserved, whilst if care be taken not to handle the operation-ends of the instruments, and to see that these do not come in contact with any foreign matter, no risk is entailed. It is, of course, essential that the hands should be thoroughly dried on a sterilised towel, and that the trays in which the instruments are kept should be of such a nature as to allow them to dry. These are simple requisites.

Masks.—In the Tropics, for every intra-ocular operation, the surgeon, his assistant, and any bystanders who lean over the patient, should wear some simple form of mask.

Fans.—Those who operate in tropical and subtropical climates, at temperatures varying from 80° to 120° F., are obliged to work under fans. In order to prevent infection of the wound from these very necessary adjuncts to comfort, the fan blades should be wiped, immediately before operation, with a damp cloth which has been soaked in perchloride lotion, and the body of the fan should be enclosed in a linen sack, similarly wetted before commencing the morning's work.

The Arrangement of the Patient on the Table.—The patient is laid on a table with his feet towards the window and his head resting on a small pillow, which is so arranged that its edge is level with his face on the side of operation. Those surgeons, who use an irrigator, will find this a not unimportant detail, as it enables the nurse, who holds the tray for catching the escaping irrigator fluid, to keep both hand and tray well down out of the surgeon's way. It is most necessary, in the East, to have the forehead and scalp

firmly wrapped in a clean towel soaked in biniodide lotion (1 in 3000).

The Method of Bandaging.—The bandage used in Madras was introduced by the writer in 1897. It is, in his opinion, greatly preferable to any other bandage when the two eyes require to be closed (Fig. 60): A piece of bandage cloth is taken 4 inches broad, and of such a length that it will pass one and a half times round the patient's head.

Fig. 60.—The Madras Cataract Bandage. The figure to the left shows the patient when he comes on the table ready for operation, but with the middle tails hanging down, instead of being rolled up and pinned, as they should be. In the middle figure, one tail of the bandage has been pinned in position, the other still hangs down. The figure to the right shows the bandage completed as the patient leaves the operating table.

The mid-point of the strip is placed over the patient's external occipital protuberance, and the two free ends are held in front of the face by an assistant; the position of the two ears, and the size of their bases, are carefully measured on the bandage. This is now removed, and two holes are cut, one on each side, to fit the bases of the ears. The object of so doing is to fix the bandage so that it cannot slide up or down. Each free end of the bandage is now slit into three tails from before backward to a point opposite the patient's temples; each centre tail is $2\frac{1}{2}$

inches broad, while the breadth of each of the four remaining tails is three-quarters of an inch.

To apply the bandage, the ears are fitted through the holes made for them, and the two upper and two lower tails respectively are tied together, the one pair over the vertex and the other below the chin. The tails of the middle pair are each rolled up and fastened by a pin, to avoid unnecessary contamination. The patient is brought on the table with the bandage thus applied. After operation, one of the two broad tails is brought down across the dressings and held in position by an assistant, while the operator brings the remaining tail over on top of the previous one, and fixes the bandage by means of a pin applied at each side.

At each dressing the pins are removed, the two broad tails are thrown backward, and the dressings are changed. The eye is then closed by reapplying the middle tails in the same way as before.

By this contrivance we are able to dress our patient without raising his head from the pillow, or in any way disturbing him. Another advantage is that firm and graduated pressure can be very easily applied when necessary.

After operation in many Eastern hospitals, the patients walk back to bed, an exception only being made in the case of old, feeble, or nervous people. It is wise, however, to insist that all cataract patients should be carried back to their wards on a stretcher. The large numbers dealt with, and the habits of the patients, necessarily modify the arrangements adopted in different hospitals. A visitor to the wards after a cataract morning in a tropical hospital will probably find most of the subjects sitting up, discussing the earlier events of the day. The prevailing spirit is, however, calm and fatalistic, and the result is that harm is not often done. The average Eastern patient welcomes a period of inactivity, which he looks upon as a happy interlude in his life of labour. With Western patients, the sense of anxiety is greater, but the habit of disciplined self-control is far more highly developed; and with such it is our rule to have them carefully carried

back to bed, or if possible to operate on them in their beds, and keep them immobile for 5 or 6 hours afterwards. Whilst on this subject there is one more point which deserves notice, namely, the steady behaviour on the table of educated English people, as compared with that of many of the Indian patients. Here again the habit of self-control is a powerful factor in the favour of a happy ending to the operation.

CHAPTER IV

METHODS OF OPERATING FOR CATARACT

THERE are two distinct methods of operating for cataract—(*a*) By delivery of the lens entire in its capsule—the so-called Intra-capsular Operation; and (*b*) by opening the capsule, and leaving it or the main bulk of it behind, while the lens substance is expressed—The Capsule-Laceration Operation.

In the East, where the opportunities for trying different methods of extraction are very exceptional, there is considerable difference of opinion amongst experts as to the relative value of these two methods. The advantages claimed for the intra-capsular operation have been as follows — (1) Unripe cataracts can be removed without waiting for maturity; (2) cortex is not left behind to give trouble, and the percentage of iritis is consequently lower; (3) after-cataracts, due to the leaving behind of capsule and of lens masses, are avoided; and (4) complications during recovery are fewer. Special stress is laid on the impossibility of the occurrence of dangerous capsulo-corneal synechiæ.

The advocates of the capsule-laceration operation are by no means willing to accept these contentions in full, and urge against the other method—(1) That its technique is much more difficult than that of their operation; (2) that a special and highly expert assistant is required for it; (3) that it is attended by a greater percentage of vitreous loss than the older operation, and that, apart altogether from this, the large number of upward dislocations of the pupil, which follow the operation, point to a distinct and serious disturbance of the vitreous body; (4) that, though there is no capsule to adhere to the wound, the vitreous

body itself is not infrequently caught therein; further, that distinct after-cataracts do occur as a result of changes in the anterior layer of the vitreous.

It would be impossible in the space at our disposal to discuss this matter adequately. The author has no wish to prejudice the young surgeon in either direction, but since his object is to make this chapter as practical as possible, he would confine himself to saying that, in his experience, and he has tried both methods freely, the capsule-laceration operation is both easier and safer than the other. It is, therefore, to his mind the obvious method for beginners. He would most strongly advise all those who can do so, to visit the men whose cataract opportunities are large, to see their work at first hand, and then to decide which method they will adopt, or whether they will use both according to rules which experience leads them to formulate for themselves. References will be given at the end of this chapter to some of the more relevant literature on the subject, but considerations of space forbid us from doing more than giving a description of the method of extraction which has long found favour in Madras, and which, rightly or wrongly, the author believes to be unrivalled for dealing with mature cataracts. If it is necessary to extract an immature cataract, it must be conceded that the intra-capsular method has advantages.

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CHAPTER V

THE MADRAS CATARACT OPERATION

By Lieut.-Col. H. Kirkpatrick

INTRODUCTORY

The technique of this operation has been built up by successive Superintendents of the Government Ophthalmic Hospital, Madras. The following article has been written and illustrated by the present incumbent of the post, and is framed in the Museum of the hospital for the instruction of students. The author is greatly indebted to Colonel Kirkpatrick for permission to use it.

First Stage

LACERATION OF THE CAPSULE

The eye has been cleaned and cocainised. The pupil has been dilated by atropin, and the patient has been given an injection of morphine and atropin.

A speculum is introduced between the eyelids (Fig. 61). The surgeon takes a pair of conjunctival fixation forceps in his left hand (which he rests on the patient's face), places them perpendicular to the surface of the eyeball, and seizes the conjunctiva just below the limbus. Taking a very light hold of a Bowman's needle in his right hand, he enters it in the limbus at the level of 9 o'clock and passes it across the pupil, turning the cutting edge against the anterior surface of the lens capsule. A downward stroke is then made so as to convert the horizontal rent

in the capsule into a T-shaped one.[1] The needle is then withdrawn gently. The instrument should not be grasped, but allowed to lie on the fingers during this manœuvre. An assistant passes his hand over the surgeon's arm and pulls the orbicularis muscle over the superciliary ridge so that the patient is unable to squeeze. (S in the pho-

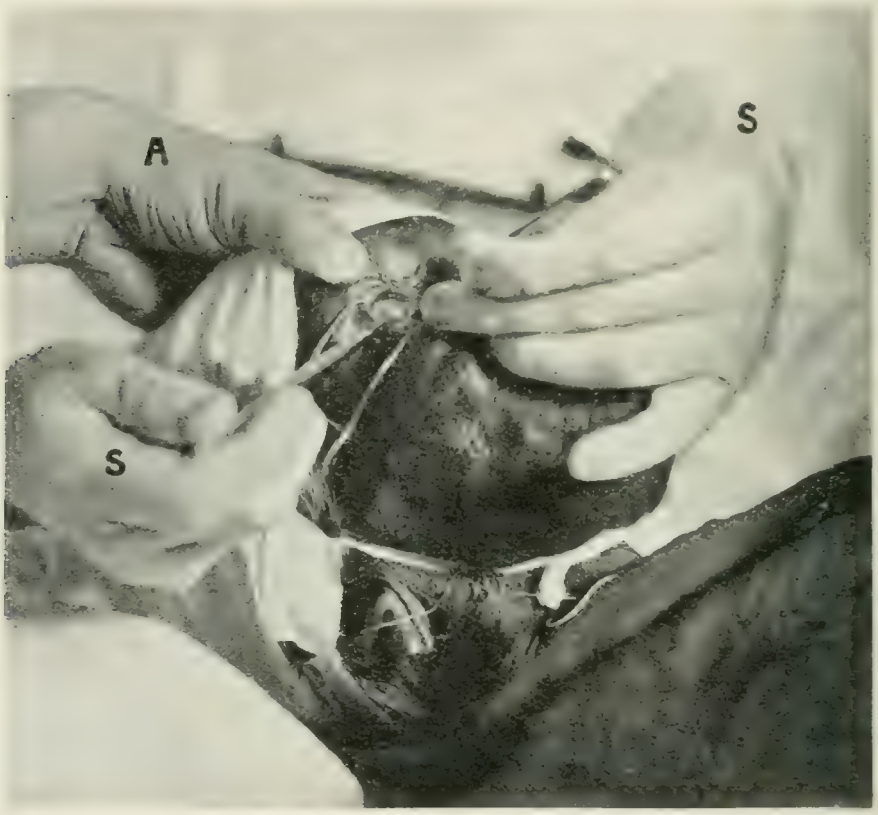

Fig. 61.—Laceration of the Capsule.

tographs marks the surgeon's hand, and A that of the assistant.)

Complications at this Stage.—1. The iris may be pricked by the needle during its introduction. If this happens, the needle should be withdrawn for a short distance, so as to disengage from the iris tissue, and again intro-

[1] The author prefers to cut a clean piece out of the centre of the anterior capsule by making two strokes with the blade-edges of the needle, one upward the other downward; the excised piece of capsule can often be seen to fall free in the anterior chamber. This manœuvre can only be carried out if the cortex is moderately resistant, and not when it is fluid or semi-fluid.

duced on a more anterior plane. (In this connection it should always be remembered that an instrument in the anterior chamber appears to be nearer the surface than it really is.)

2. The aqueous humour may leak out alongside the shaft of the needle, and the chamber be emptied. The usual causes of this are (1) too tight a grip of the needle, (2) too violent movements of the same, and (3) the blade of the instrument cutting too large a hole for the shank to fill; a needle that has been *once* re-ground is best suited for the purpose, for the blades, as usually supplied, are too wide. Should it occur, the chamber may be refilled through the needle aperture by the irrigator.

Second Stage

THE SECTION

The conjunctiva is fixed as in the first stage (Fig. 62). A Graefe, or similar knife, is entered in the track of the needle and passed across the anterior chamber towards half-past 2 or 3 o'clock, until only a vestige of iris appears to lie between its point and the angle of the chamber; it is then passed out at the corneo-scleral margin, with a forward and upward movement of the fingers, till nearly the whole length of the knife has engaged, when the fingers draw it upwards and backwards, these movements being repeated until the knife slowly emerges at the upper edge of the limbus and the " section " is completed. It is well to ascertain the plane in which the ring formed by the limbus lies, and to pass the knife with its plane tilted forward at a slight angle to the above. It is of the utmost importance not to grip the knife, but to hold it in the fingers as lightly as possible, and allow it to find its own way through the tissues. There need be no hurry if the eye is not dragged about.

The orbicularis muscle may be controlled by an assistant, as in the first stage, if the patient is inclined to squeeze his lids unduly.

Complications.—1. The point of the knife may emerge too deep. Should it appear in the sclera it is best to withdraw it into the anterior chamber and pass it farther forwards.

2. Difficulty may be experienced in cutting through the tissues. This *may* be due to bluntness of the knife,

Fig. 62.—The Section.

but is much more probably due to the surgeon not applying force in the plane of the knife blade, *i.e.*, trying to cut with the flat of the knife instead of the edge. Remedy: Pause in the section, hold the knife more loosely, and use only finger movements as in writing.

3. The iris may ride over the knife. Caused by the plane of the knife being tilted too far back and the section being made with the flat of the blade instead of its edge.

Remedy: Slacken the grip on the knife, tilt it slightly forward, and cut on through the iris.

N.B.—The greatest care should be taken not to touch the edge of the lids with any part of the knife, since infective matter may be carried on it into the eye.

Third Stage

THE IRIDECTOMY

The iris forceps is taken in the left hand (Fig. 63): all

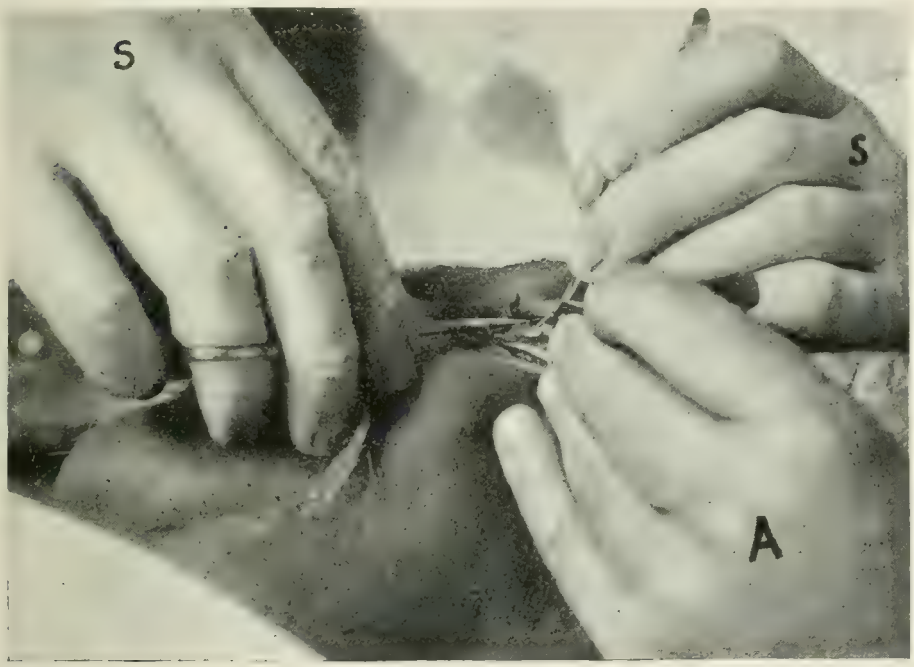

Fig. 63.—The Iridectomy.

moisture is jarred off its blades by flicking the handle with the right thumb. The scissors are taken in the right hand and held by the ring finger and thumb. The orbicularis muscle is pulled over the superciliary ridge by the ring and little fingers of the left hand whilst the iris forceps, held by the first and middle fingers with the thumb, is introduced into the section. At the same time the scissors are placed in position ready to cut the iris when withdrawn. To ensure steadiness, the tips of the fingers of the right

hand are supported on the patient's cheek. *Extreme care should be taken not to touch the edge of the lid with the iris forceps whilst they are being introduced.* The iris is now *very gently* taken hold of by the forceps and snipped off directly the fold is clear of the section. The cut should be made in a vertical direction so as to leave as narrow a gap as possible. It is advisable for an assistant to steady the eyeball by a fixation forceps. This is applied close to the limbus and above the section, on the nasal side of the right eye and the temporal side of the left.

Complications.—1. Occasionally, when the cortex of the lens is very swollen and soft, the nucleus slips in front of the iris and renders the latter difficult to lay hold of. These cases are the most suitable for a simple operation, and the iris may be left alone. If desired, it will generally be possible to catch the iris if the forceps are rotated so as to bring one blade downwards; or, should this fail, an iridectomy may be done after the lens has been extracted, if the iris be seen to be a very flaccid one.

2. The patient may drag on the iris before it is cut and tear it away from its attachment. This is guarded against by a light hold of the iris and a quick snip of the scissors. If it occurs, the ragged edges of the iris should be cut away as well as possible, and the operation proceeded with. If a patient is uncontrollable, and persists in looking up, it is best to discard the fixation forceps and speculum, to introduce a Smith's hook under the upper lid, and to drag it upwards and forwards; it will often then be fairly easy to catch the iris by introducing the forceps obliquely. The patient seldom moves his eye once he assumes this rolled-up attitude.

Fourth Stage

DELIVERY

The surgeon holds the orbicularis muscle above the superciliary ridge with the fingers of his left hand (Fig. 64). The assistant pulls the cheek downwards with the fingers of

one hand, and lifts the speculum forward with the other. The surgeon takes a curette in his right hand, and makes a light stroking movement on the sclera behind the upper lip of the wound, so as to press the upper margin of the lens downwards through the rent in its capsule. As the lens slips downwards, the pillars of the coloboma spread out and the shape of the pupil alters. He now carefully ascertains the plane in which the ring formed by the limbus

Fig. 64.—Delivery.

lies and, laying the curette over the lower quarter of the cornea, makes a light pressure perpendicular to this plane. If the previous stages have been carried out correctly, the upper edge of the lens will immediately appear between the lips of the wound ; as it emerges, the direction of the pressure should be altered to an upward one towards the section, and the lens followed up on its course. Should it hang in the section, light pressure may be made at each angle, or it may be impaled on a Bowman's needle and pulled out.

If pressure be made in the right direction, difficulty in making the lens present is due either to not having cut the capsule completely, or to the section being too small.

If there be any doubt as to the capsule being sufficiently lacerated, this should be thoroughly done with a cystotome, needle, or knife. If the section appears to be too small, the blade of a clean pair of scissors may be passed into one angle of the wound, and the incision increased in size. A large lens may often be induced to pass through a small incision, by first causing the lips of the section to gape slightly, by making pressure below with the curette, and then impaling the lens on a clean needle and "wheeling" it out of the incision.

If the pressure is not applied in the right direction, the upper edge of the lens may pass up under and behind the upper lip of the section instead of in front of it, and so refuse to present. If this occurs, the section should be made to gape as before, and the lens be pushed down with a clean needle and then delivered, or, if the section is sufficiently large, it may be delivered with the lower edge first, *i.e.*, "tumbled."

Fifth Stage

IRRIGATION AND TOILET OF THE WOUND

The surgeon fits the irrigator nozzle into the rubber tube, and wraps a piece of sterilised wool, lint, or gauze round the junction, so that any leakage there may be absorbed, and not run into the eye, after having been infected by passage over a finger. He holds the tube between the finger and thumb of the left hand in order to regulate the flow of fluid, and fixes the orbicularis muscle over the superciliary ridge with the three outer fingers of the same hand (Fig. 65). The assistant holds the speculum forwards, and, with a finger or thumb of his other hand, pulls the orbicularis down. The surgeon supports his right wrist on the patient's forehead, and, holding the irrigator nozzle lightly in that hand, first allows a little fluid to escape

over the patient's face. He then directs the stream on to the lips of the wound and fills the anterior chamber, allowing a whirl of fluid to run behind the iris; whilst keeping the stream flowing freely, he then makes a series of light stroking movements in each meridian of the cornea in turn, passing from just outside the limbus to the centre; as he does so, he will see fragments of lens

Fig. 65.—Irrigation.

matter pass into the pupil and be washed out of the section by the stream of fluid.[1] In a few moments the pupil will

[1] If masses of cortex are imprisoned beneath the upper lip of the incision the nozzle of the irrigator should be turned round, so that the stream is directed backward and upward. This will usually wash out the mass at once. If it does not do so, a pair of iris forceps may be introduced, and a portion of the capsule in the neighbourhood seized, drawn toward the pupil, and then extracted. The shallow bag, formed by the upper cul-de-sac of the capsule, is thereby everted, and its cortical contents are emptied into the chamber, whence they can be easily washed out. This, however, is a difficult manœuvre, and is not recommended to beginners.—(Author.)

appear quite black. Should any cortical mass resist dislodgment, he may take a clean nozzle and, passing it into the chamber, allow the stream to play directly upon it ; this will rarely be necessary. When the pupil is quite black, the iris can be replaced, by directing a gentle flow of fluid on to the angles and lips of the wound. The "toilet" of the wound can generally be effected in this way, but, if there is any doubt about the edges of the

Fig. 66.—Smith's Lid-control in Cataract Extraction.

wound being in proper apposition, an iris spatula may be introduced and the edges cleared and replaced with it. It is often useful to massage the section lightly through the closed lid, but in doing so care must be exercised not to bring the edge of the lid into contact with the wound, or to allow moisture to flow from the surface of the eye into its interior. A drop of atropin is now instilled, and the eye closed and bandaged. Great care should be taken to have the whole irrigator and its contents thoroughly

sterilised before use, according to the directions already given in Chapter III.

SMITH'S LID-CONTROL IN CATARACT EXTRACTION

This manœuvre is of such value that it merits a short description.

The assistant stands on the patient's left side and passes a lid-hook under the upper lid (Fig. 66). The hook is held between the thumb and first finger of the right hand; the three outer fingers of this are used to push the orbicularis muscle above the superciliary ridge. In doing this the palmar surfaces are turned towards the patient's feet. The lower part of the orbicularis is held below the lower orbital margin by the left thumb.

If the lid is now drawn forward, it carries with it the orbital connective tissue with its attachments to the aponeurosis, check ligaments, capsule of Tenon, and ocular muscles. The posterior pole of the eyeball is thus sucked towards the apex of the orbit, carrying the vitreous body with it. so that an escape of vitreous is unlikely to occur.

CHAPTER VI

WARNINGS AND RULES

The object of this chapter is to warn the cataract operator of certain dangers, and to furnish him with a few simple rules for his guidance. The author has had an exceptionally large experience in the teaching of operative work on the living, to beginners and others, and has been most forcibly struck by the fact that practically every man who has not had large practice makes identically the same mistakes.

Some important Warnings.—If an inexperienced operator is watched while at work, it will be observed that he frequently allows his knife or needle to rub on the margin of the lid, whilst he is introducing it. He is so much taken up with his point that he has no eyes for the rest of his knife. It is obvious that this is a dangerous habit, and one that needs careful avoidance. The writer's practice is to rotate the eye inwards, by means of the forceps, during puncture, and until the moment of counter-puncture ; the eye is then brought back to the midline for the finish of the section. In this way the lid-margin is easily avoided, more especially so, if the temporal lashes of the upper lid have been cut short the day before operation.

Another point often overlooked is the care of the speculum. One frequently sees an operator brush the sterilised speculum on the lid-margins whilst inserting it. If the assistant depresses the lower lid, whilst the operator raises the upper, and at the same time introduces the speculum with care, there is not the least reason to contaminate the instrument.

No instrument should be used twice without being sterilised in between. It might seem unnecessary to

insist on the importance of not allowing the operation-ends of the instruments to touch the operator's hand, the pillow, the patient's face or anything else except the eye ; but these kinds of accidents happen so often that the warning is *not* needless. The fact is, that the surgeon has so many things to think of (until his experience is so large that he operates without conscious effort), that he may very easily forget these important details. If one may compare great things with small, it is like the tyro at golf, whose head is so full of the many things that he must and must not do, that he often ends by missing the ball altogether.

Some simple Rules :

1. Never be in a hurry, there is plenty of time.

2. Take a light hold with the conjunctival forceps, and avoid pressure on the globe. It is this forceps-pressure on the globe that leads to so much vitreous escape. The object of the forceps is *simply to steady the globe.*

3. Enter your knife point in the needle puncture ; it will slip through more easily, and will fill up the hole at the same time, thus avoiding aqueous leakage.

4. Do not rotate the knife on its axis, or aqueous will escape.

5. Do not carry the counter-puncture back into the sclerotic ; it adds much to the difficulty of the section. Learn to bring it out in the corneo-scleral junction. This is more difficult than it sounds, for the knife point always looks nearer the cornea than it really is, like a stick does when seen through water.

6. On making the counter-puncture, push the blade boldly on with a sawing movement, so as to make a large part of the section in the first cut. At the same time, turn the edge of the blade slightly forward, so that it may ride harmlessly over the iris. This turn should be made almost with the counter-puncture. It saves the iris from being scraped.

7. Cut in the plane of the knife-blade, and not at an angle with it. If this direction is obeyed, a sharp

knife cuts its way out *without effort.* Don't grip your knife tightly ; hold it lightly, and trust to its sharpness, and not to brute force.

8. Do not attempt brilliant sections. Finish your section slowly and gently. This will lessen the danger of sudden squeezes of the lids, which are likely to cause vitreous escape.

9. To minimise the size of the artificial pupil, seize the iris near its pupillary edge with a narrow grip, and cut, holding the scissors at right angles to the corneal section.

10. Do not pinch the iris with the forceps, but seize it as gently as possible. Also avoid all drag on it. You will thus give your patient no pain ; he will not shrink, and you can do your operation easily, without fear of pulling the iris edges into the section, and impacting them there.

11. Make your section big enough for easy delivery ; *small sections provoke disaster.* You should learn by the use of the needle during laceration of the capsule what kind of lens mass, and, to some extent, what *size* of lens mass to expect ; and you can graduate your section accordingly.

12. Be content with the delivery of the nucleus, and of any cortex which readily accompanies it, by manipulation. Anything left can easily be washed out. This is a safe and an easy procedure.

13. Replace the iris thoroughly. One should not rest content until a key-hole pupil is obtained.

14. If the pupil looks very black, and the vitreous body presses against the cornea, obliterating the aqueous chamber, it is a sure sign that the hyaloid membrane is thin, and that vitreous escape will ensue if the operation be pushed. Close the eye at once.

15. Never interfere with an opaque posterior capsule left after delivery of the lens. It is more safely and better dealt with later by discission, after the section is soundly healed.

16. Remove floating portions of the anterior capsule with iris forceps, but be ready to close the eye at once, if vitreous threatens to present in the wound.

17. If a lens fails to present in the section, when pressure and counter-pressure are applied, the failure may be due to—(1) Insufficient laceration of capsule, (2) dislocation of the lens upward beneath the sclerotic lip of the incision, (3) falling down of a Morgagnian nucleus into the lower part of the chamber, (4) too small size of incision, (5) if iridectomy has not been done, to rigidity of the iris, and (6) if the suspensory ligament of the lens has ruptured, to the lens having fallen backward into the vitreous.

Insufficient laceration is met by lacerating the equator of the lens with a knife or needle, through the section.

18. Great care should be taken to avoid a lens delivering by rotation on a horizontal lateral axis (right to left axis) ; this puts a dangerous strain on the hyaloid membrane ; it is due to dislocation of the lens under the sclerotic lip ; the upper part of the lens becomes fixed there and the lower can only deliver by turning upwards and forwards on the horizontal axis. This should never be allowed if it can be avoided ; the chamber should be washed out, and the position of the lens exactly ascertained. It can then be replaced by pressure with a curette and easily delivered.

19. A lens, which is a tight fit for its section, may often be delivered quite easily by rotating it, when once impacted in the section, on its antero-posterior axis ; this can be done with a curette applied to the edge, and stroked round it ; the action is like that of turning a cart-wheel on its axle, by seizing the tyre and turning it round.

20. When the chamber empties during needling, owing to the blade of the needle being too large, or to the knife having been introduced with its edge the wrong way, or to any other cause, the chamber may be easily refilled, through the small puncture already made by pressing the nozzle of the irrigator against the puncture, and turning on the stream. One is at once placed again in the position of working with a full chamber.

CHAPTER VII

THE AFTER-TREATMENT OF EXTRACTION CASES

Only a few of the leading points can be taken up.

Dressings.—The eye must be shut off from light, dust, and draughts. Aseptic pads are preferable to antiseptic applications, as the latter irritate the skin in hot countries more readily than they do in Europe. No pressure must be put on the eye, or the corneal flap will override the sclerotic and heal in a faulty position. If, however, the section tends to gape, pressure is of value. On the other hand, if the eye has recently been the seat of any form of conjunctivitis, it is undesirable to lock up purulent secretion in the conjunctival sac. Under these conditions, a perforated convex shield should be placed over the eye, with a layer of dressing on its outer surface; or, a pair of Kirkpatrick's goggles (Fig. 67) may be used. If a case has been under active treatment for catarrh for six weeks, the surgeon need wait no longer, but may operate boldly provided he takes the above precautions.

Every operated eye should be inspected within the first 48 hours; then, if all goes well, it may remain closed for 3 days; after that, it should be dressed daily. The unoperated eye may be opened, if all is well, on the 4th day, and the second eye on the 8th day. A shade should then be worn over both eyes.

Post-operative Conjunctivitis. — This, which is nearly always present, varies greatly in degree in different cases. During the first week, argyrol drops (12½ per cent.) should be used at each dressing, if the redness is at all marked. After that an astringent may be required. The author's practice, then, is to instil zinc, alum, and boric

drops [1] in the morning, after a preliminary drop of cocaine, and to reserve argyrol (12½ per cent.) for the midday and evening treatment.

Acute Iritis and threatened Panophthalmitis.—The treatment consists of—(1) The free instillation of atropin drops (grs. 8 ad ℥i of water); (2) the administration of a brisk purge; (3) the application of four good-sized leeches

Fig. 67.—Cataract Goggles.

round the orbital margin; followed by (4) the free use of fomentations; and (5) the injection of 1 c.c. of a solution of bicyanide of mercury (1 in 3000) under the conjunctiva. This injection may be repeated every day for three or four days, and sometimes seems to be of great value. Kirkpatrick has had very good results in these cases from the

[1] Zinc sulphate, grs. 4; alum sulphate, grs. 2; boric acid, grs. 10; distilled water to an ounce.

irrigation of the conjunctiva with a saturated solution of magnesium sulphate.

It is necessary to distinguish sharply between the acute iritis, which usually commences on the third day, and which is due to septic infection of the wound at the time of operation, and that which is delayed until the 8th to 10th days, and which is to be ascribed to some source of auto-intoxication. In the latter case, it is important to ascertain the nature of the toxic focus, and to remove it, though this should really have been done before the operation. Dental sepsis, suppuration of the nose, throat, or ear, and syphilis are the three factors which must be prominently borne in mind in this connection, but, as in all auto-intoxications, there are others, which must also be considered. Before dismissing the subject, the author would like to impress on the reader that the real danger-point in the third-day infections in tropical countries lies in the conjunctiva. Ordinary care will avoid every other source of trouble, but only the closest attention to detail will save him from this.

Sub-acute Iritis.—The use of subconjunctival injections of normal saline solution is of great value in combating this complication. It should, of course, be combined with the ordinary therapeutic means at our disposal, such as the use of atropin and dionin, the application of blisters, the administration of purgatives, etc. It reinforces and hastens the action of the other treatment.

Retained Cortical Masses.—The absorption of such masses can be promoted in the early stage by the free use of subconjunctival injections. Later on, dionin is of great value. In both cases atropin should be used as well, to break down synechiæ and to establish a wide pupil.

Keratitis.—A certain amount of keratitis not infrequently follows cataract extraction, and should be treated on ordinary lines. In patients whose conjunctivæ have been irrigated with the perchloride lotion, a definite filamentary keratitis is common; it clears away of itself, but its departure is probably hastened by the use of argyrol.

Prolapse of the Iris.—If this occurs, the prolapsed

portion should be excised after carefully opening the section, with all antiseptic precautions, as if for a major operation. The patient should be given a hypodermic of morphia 15 minutes before the operation; cocaine and adrenalin solution should be freely instilled into the sac, and should also be injected under the conjunctiva. If the iris appears to be pushed into the section by a bulging of the vitreous, it is better not to attempt removal, but to rely instead on firm pressure-bandaging, and the use of eserin.

Leaking Section.—This is not common. When due to age or malnutrition, the patient should be put on a suitable diet. The eye should be kept closed, a few drops of silver nitrate solution (3 to 5 grs. to the ounce) should be daily instilled, and the patient should be kept in bed, if possible.

After-Cataract.—In Madras, it is customary to lacerate

Fig. 68.—Ziegler's Knife-needle.

uncomplicated after-cataracts with two needles, being careful to use the cutting edges of the needles and not to plough the vitreous deeply. The results so obtained have been excellent. There is, however, much to say in favour of the use of a Ziegler's knife (Fig. 68). Atropin should be freely used after any operation for this complication. Many operators tear the capsule a week after the main operation, but it is far safer to wait a month or six weeks before doing so.

Injury to the Eye after Operation.—This is usually followed by free bleeding into the chamber. Bandaging of the eye, with rest and the use of atropin, suffices to meet this complication. An after-cataract is not infrequently left; it must be dealt with later. It is a good thing to tie a nervous patient's hands to a belt, which is fitted to his waist, and provided with bands, which encircle

the wrists (Fig. 69). In this way he is prevented from reaching the eye with the fingers. The risk of injury is greatly accentuated in India by the habits of the patients, who cannot be persuaded to lie still after operation.

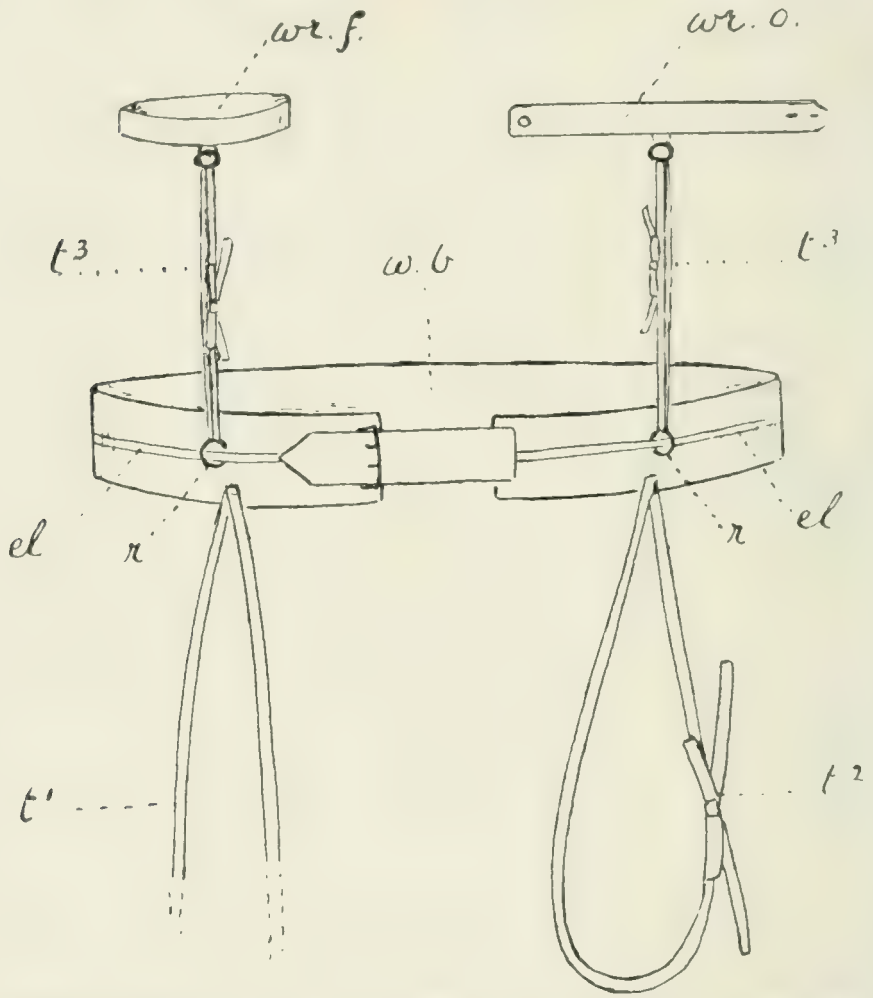

FIG. 69.—Cataract Belt. *w.b*, waistband ; *wr.f*, wristband fastened ; *wr.o*, wristband open ; t^1, tape to go round right thigh (shown unfastened) ; t^2, tape to go round left thigh (shown tied) ; t^3, tapes for wristbands ; *r*, rings to run along elastics (*el.*).

Many of them insist on sitting up ; this seems to do surprisingly little harm in most cases.

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CHAPTER VIII

THE FREQUENCY OF CATARACT IN TROPICAL COUNTRIES

It is often confidently stated that cataract is much commoner in India, and in certain other tropical countries, than it is in Europe. Before accepting such a conclusion, it is important to bear in mind the paucity of ophthalmic surgeons in such parts, in comparison with the ophthalmic material to be dealt with; *e.g.*, for many years there was only one fully equipped eye hospital for the Presidency of Madras, inclusive of the native States within its borders, while the total population catered for was nearly as great as that of the British Isles. To a visiting surgeon who sees from 20 to 40 cases come on the operating table, on the weekly cataract morning, the impression will be that of a great prevalence of the disease; but this requires to be corrected by a knowledge of the facts given above.

Again, attention has been called to the very large number of cataract operations performed in the Punjab and in the N.W. Provinces as compared with those in Madras or Burmah. The suggestion is that it is a question of the affection of the lens by the excessive dry heat of the inland areas, for the glare in such districts is very great. Dr. Neve, of the Kashmir Mission, believes that the prevalence of cataract is more easily explained on the theory that it is due to light, than on the view that it is caused by the special diet of the people; he points out that it is, both relatively and actually, more common amongst the Mohammedans than amongst the Hindus in Kashmir, and that the former are more exposed to the influences of the climate by reason of their occupations;

he finds cataract to be very prevalent where the climate is very dry; the absence of atmospheric moisture in such parts makes the air very clear and the light very bright; while the glare off the dry ground is excessive.

In the Census Report of India for 1901, it is stated that "The prevalence of blindness is to a great extent determined by climate, where the glare and dust are highly prejudicial to the eyesight, and is comparatively rare in a cool or damp country, where a profusion of vegetation rests the eye, and where there is a comparative absence of dust." The distribution of the blind is said to be in accordance with these considerations, being most common in the dry hot areas, and much less so in the cooler damp ones. Cataract bulks very largely as a tabulated cause of blindness in India, and its relative prevalence is possibly indicated in the above remarks. With regard to other tropical regions, our data are very insufficient. Whilst not really dissenting from the above views, there is a point the author would like to linger on for a moment. The number of cataract operations in a district or province of India, is not necessarily to be taken as a close index of the frequency of the occurrence of the condition there. Vast numbers of cataract patients hide, unsought and uncared for, in the villages, and die in their blindness. The gospel of an eye surgeon in the neighbourhood, who is removing cataract and conferring sight on the blind, draws like a magnet. It is not even necessary that the operator's percentage of success should be very high. What is important is, that he should be an enthusiast, that he should be approachable, and that his term of work should be a long one in the same neighbourhood. In many tropical lands, and certainly not least in India, the personal factor must be taken into account in watching surgical statistics. A district may at one time show a very meagre return of operations of a particular nature, and yet a few years earlier or later, the numbers operated on may have been or may become very large. The secret lies in the personality of the surgeon in charge for the time being. The conditions of service and opportunity at the periphery of

Empire are very different from the humdrum level of European practice.

Treacher Collins has pointed out that the lower part of the lens is commonly the seat of commencement of senile cataracts, and he thinks that this is possibly evidence that the action of light is the cause of the opacification of the lens; for, inasmuch as the light comes down from above, it is obviously the lower part of the lens which is most exposed to its influence.

Attention has from time to time been called to the frequency of cataract amongst glassblowers, as evidence of the possibility that heat and glare may produce opacities of the lens in tropical climates. The force of this argument must be admitted, but at the same time, it is to be pointed out that the type of cataract commonly met with in India is not widely different from that seen in Europe; it certainly is not of the type with which we have become familiar from the writings of those who have had large experience with glassblowers' cataract.

Then, again, account must be taken in this connection of Widmarck's experiments on rabbits, by which he was able to show that strong ultra-violet light is able to produce karyokinesis and proliferation of the lenticular epithelium. In severe cases there is destruction of the nuclei, breaking down of the cells, and swelling of the cortical fibres, with exudation among the latter, and also between them and the capsule. A *prima facie* case is thus made out in favour of the view that light may produce opacification of a lens.

It would be of interest to know whether Europeans, who have served in India, are more liable to cataract than those of their own class who have not; they mostly retire too young to show signs of it out there, and it is amongst the pensioners and their wives and relatives that the evidence required must be sought. It is difficult to speak positively, but during the years he has been working in England since his retirement, the author has met with a proportion of cataract amongst retired Anglo-Indians, that strongly suggests that residence in the East influences the liability to the disease.

It must be confessed that we have very little definite knowledge as to the causation of cataract in the Tropics. We do not even know with any degree of certainty what its relative frequency is in temperate and tropical climes. A great field for investigation is open to the young surgeon. The collection of large statistics and the very careful survey of the figures so obtained will suffice to provide the enthusiast with years of work, and may open up very important avenues to knowledge.

SECTION VIII

DISEASES OF THE CONJUNCTIVA. THE CORNEA, THE LIDS, AND THE LACHRYMAL PASSAGES

INTRODUCTORY

PART. I.—DISEASES OF THE CONJUNCTIVA

Chapter I. Phlyctenular Conjunctivitis.

„ II. Trachoma.

„ III. Some Complications and Results of Trachoma.
Pannus.
Pannus Ulceration.
Upper Marginal Pitting of the Cornea.
The Sinuous Lid Border.

„ IV. Some Results of various Forms of Chronic Conjunctivitis.
Conjunctival Bridges and Pouches.
Cysts of the Conjunctiva.
Essential Shrinking of the Conjunctiva.

„ V. Parinaud's Conjunctivitis.

„ VI. Samoan Conjunctivitis.

„ VII. Spring Catarrh.

„ VIII. Filarial Conjunctivitis.

„ IX. A Distinctive Conjunctival Pappule.

„ X. Miscellaneous.

PART II.—DISEASES OF THE CORNEA

Chapter I. Superficial Punctate Keratitis.
Herbert's Disease.
Westhoff's Disease.
Kirkpatrick's Disease.
" II. Filamentary Keratitis.
" III. Herbert's Corneal Plaques.
" IV. Lead Incrustation of the Cornea.
" V. Septic Ulceration of the Cornea.

PART III.—DISEASES OF THE LIDS

Chapter I. A Rare Form of Subconjunctival Granuloma met with in Central China.
" II. Other Unusual Thickened Conditions of the Lids.

PART IV.—LACHRYMAL OBSTRUCTION

INTRODUCTORY

The present section presents greater difficulties than any other part of our subject. To write an ordinary text-book description of the diseases of the conjunctiva, the cornea, the lids and the lachrymal passages, would be a work of supererogation. The end in view is to draw attention to those diseases, which are peculiar to the Tropics, or which occur with unusual frequency there, or which are modified either in character, or in the line of treatment they require, by virtue of their tropical environment.

In no part of our subject are we made more conscious of the many missing links in the chain of our knowledge ; indeed, it would be almost more correct to say that but a few of those links are in our possession, and that the chain as a whole cannot yet be said to exist. Moreover, our knowledge of even such links as we do possess is partial and unsatisfactory, and may well have to be modified in the light of fuller experience.

All we can hope to do is to show what has been done in the past, and so to endeavour to induce others to carry on the work which has been so well begun. One of the great impediments to progress in the past has been the difficulty, felt by students of ophthalmology in far-away lands, of gaining access to a knowledge of what has already been done in the particular subjects which interest them. If the younger men can be put into the position to start from where the older ones left off, much overlapping of work, much unnecessary investigation, much loss of time, much discouragement, and much delay in progress will be avoided. The author is convinced that in this department of science "the harvest truly is great, but the labourers are few," and his earnest desire is to stimulate those, who hitherto have been content with routine work, to take up

side by side with it one or more branches of original investigation. To do so will make a man's life-work more interesting; he will find his pleasure increase as his studies progress, and he will be surprised alike at the interest and the ease of such investigations. The critic may observe that such remarks are repeated at intervals throughout the book. The fault, if fault it be, is deliberate. It has to do with principles, which are of such importance, that no method of emphasizing them should be dispensed with; and the present chapter affords one of the happiest opportunities of impressing on the student, that he must not live unto himself. For the moment, his opportunities are great, and since opportunity brings responsibility, he must not let any chances slip from his grasp. There are few things that the author regrets more sincerely, than his omission to study carefully and systematically the enormous wealth of conjunctival, corneal, and lid disease, which presented itself in the Madras clinic.

PART I

DISEASES OF THE CONJUNCTIVA

CHAPTER I

PHLYCTENULAR CONJUNCTIVITIS

This is very commonly met with in Eastern practice, and presents peculiarities, which have been well pointed out by Herbert, with whose description of the condition the author closely agrees.

In a considerable percentage of the cases—Herbert reckons it at about 33 per cent.—the phlyctenules occur in membranes, which are already the seat of chronic inflammation. This suggests that they are a secondary implantation, as a consequence of the local invasion of the inflamed tissues by other bacteria; it may readily be supposed, that the previously existing inflammatory process prepares the conjunctiva for the growth of the new organisms, or else that breaches in the inflamed epithelial surface provide a ready path for their entry. More rarely, the phlyctenules are found as a complication of a general acute or subacute conjunctivitis. In Herbert's experience, the "degenerate and chronically inflamed conjunctivæ, associated with xerosis, are frequently the seat of phlyctenular eruption."

Whereas, in Europe, phlyctenules are commonly limited to the bulbar conjunctiva, inclusive of the limbus, in India they are by no means infrequently found on the palpebral portion of the membrane, and especially on that portion which covers the tarsal cartilages. When they thus occur on the lids, the inflammatory action is disposed to be diffuse,

and the phlyctenules are seen to be seated "on a uniformly thickened, reddened, and usually roughened membrane." As a rule, palpebral phlyctenules are found to be associated in their occurrence with bulbar ones; "they are more commonly multiple than single, and their favourite seat is just within the lid border; they tend to spread out in a line in this position; they are more common on the upper lid than on the lower; occasionally, two or three of them join together to form an irregular, conglomerate infiltration; their characteristic acute course, and their nearly invariable association with similar lesions of the bulbar membrane are sufficient for diagnosis."

The phlyctenules, associated with xerosis of the conjunctiva, "are more often found on the lids than on the eyeball; the associated inflammatory reaction is usually very mild, while, on the other hand, there is more destruction of tissue than usual; they grow to a much larger size than ordinary phlyctenules, and very rapidly become superficial ulcers, rather by necrosis than by molecular disintegration."

Another point, which Herbert makes, and which is in accordance with the author's experience, is that of the age of the patients, for, in India, a large proportion of adults are found amongst those suffering from phlyctenular ophthalmia. In a hundred cases he found that more than a third of the patients were over twenty years of age, whilst a few were over fifty.

REFERENCE

HERBERT, H.—*Ophth. Rev.*, London, 1898, vol. xvii. p. 67. (The passages placed in quotation marks are all from the above quoted reference.)

CHAPTER II

TRACHOMA[1]

The prevalence of this scourge in Egypt, India, Persia, China, and other Eastern lands must be seen to be appreciated. If properly treated from the first, a complete cure can be guaranteed in every case ; but when neglected, as it commonly is in the Orient, it is probably responsible for a larger share of blindness and defective vision than any other single factor. An uncomplicated case may be divided into four stages—(1) Granules appear on the tarsal and retrotarsal folds with little pain, congestion, or discharge ; (2) the granules increase in number, there is papillary hypertrophy and congestion, and discharge appears ; (3) cicatrisation begins ; at this stage, islands of granulomatous conjunctiva are found inclosed in a network of fine cicatricial tissue ; (4) the granules disappear, leaving the conjunctiva smooth, but converted into a network of connective tissue.

Sooner or later in the course of the affection, as seen in the Tropics, a mixed infection takes place ; or, on the other hand, the trachomatous condition may be inplanted upon a previously existing acute or sub-acute conjunctivitis, due to one or other of the organisms which commonly give rise to this condition.

The **complications** are common and dangerous—(1) *Cicatricial entropion* : (2) *trichiasis* and *distichiasis* ; (3) *cicatricial obliteration of the fornices of the conjunctiva* :

[1] To deal adequately with Trachoma would require a volume devoted to the subject. Only the bare outlines will be given, and attention will be directed to some points of outstanding interest in tropical practice. The vexed question of the ætiology of the disease will be left alone.

(4) *ectropion*, a rare event; (5) *xerosis* of the cornea and conjunctiva; and (6) *pannus*, which is extremely common, and which may be accompanied by ulceration and cicatrisation of the cornea (Figs. 70 and 71). In this connection

FIG. 70.—Sequelæ of Trachoma. The cornea is cicatrised and opaque. The conjunctiva is cicatrised and shrunken. (Photo kindly furnished by Lt.-Col. H. Herbert.)

a rule of great value to the tropical practitioner may be formulated:

"WHENEVER CORNEAL COMPLICATIONS ARE MET WITH, EVERT AND EXAMINE THE LIDS!"

Efficient treatment of the latter will often cure the corneal condition.

Treatment.—The aim of this is the destruction of the granules. In a very early stage, the attack may be cut short by destroying the few granules present on the tarsus with a fine-pointed cautery, and by excising that part of the loose retrotarsal fold on which granules are seen. At a later stage, roller forceps should be freely used and this

Fig. 71.—Sequelæ of Trachoma. Notice the opaque cornea and the shrunken cicatrised conjunctivæ. (Photo kindly furnished by Lt.-Col. H. Herbert.)

treatment repeated once a fortnight if necessary. It can be done painlessly under ethyl chloride inhalation; the everted lids should be brushed daily with solution of silver nitrate (grs. x ad ℥i) after previously instilling cocaine and adrenalin. When the secretion has markedly lessened, the use of a copper sulphate stick is valuable. Later still, when all granules have disappeared, argyrol and mild astringents are indicated. The corneal condition is

benefited by daily treatment with an ointment of dionin (3 per cent. and upward) and yellow oxide (grs. ii–viii ad ℥i).

Herbert strongly advocates the "perchloride treatment" of trachomatous pannus and ulceration. His method consists in the washing out of the eye daily with a solution of perchloride of mercury (1 in 3000), combined with the use of atropin drops. In chronic cases the irrigation is continued for a minute or more, but where the conjunctiva is unusually sensitive, he advocates that the period should be shortened at first. He states that the pain does not last for more than five or ten minutes.

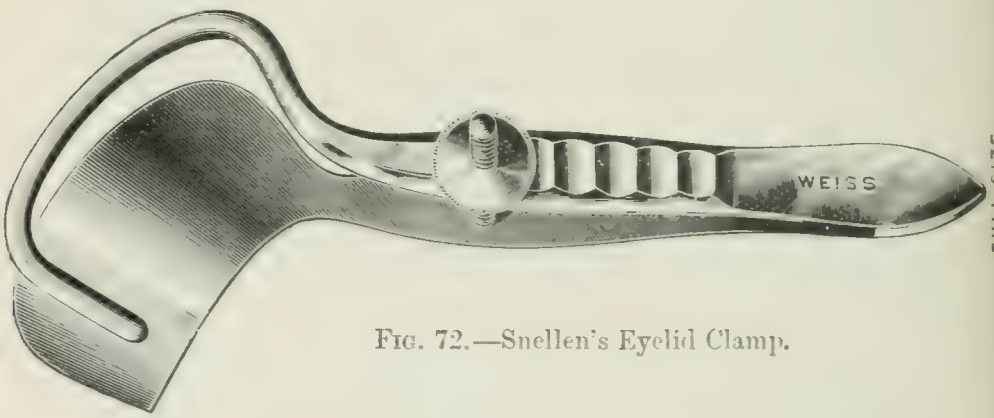

Fig. 72.—Snellen's Eyelid Clamp.

Kuhnt's excision of the tarsus and conjunctiva should, in the author's opinion, be reserved for severe and intractable cases. For all degrees of entropion, a *modified Streatfield's operation* is advised: an eyelid clamp (Fig. 72) having been applied, an incision is made immediately above the roots of the eyelashes and is carried down to the tarsus, just avoiding the hair bulbs. A crescentic incision, with its concavity towards the previous cut, is next made through the skin, meeting the extremities of the first incision near either canthus (Fig. 73); the flap of skin so marked out is dissected off the tarsus, the muscular and connective tissues being at the same time removed, so that that structure is laid bare in the floor of the wound; this is best done with a pair of scissors, curved on the flat, the convexity of the blades being turned towards the tarsus,

and the loose superjacent tissues being lifted up in the grip of a pair of conjunctival forceps. With a sharp knife the surgeon now removes a wedge-shaped strip of cartilage in the whole length of his incision. He then passes three sutures in turn (Fig. 74); each of these picks up, first, the lower edge of the skin incision, then, the upper edge of the groove in the cartilage and, finally, the upper edges of the skin incision. When these sutures are tightened, the edge of the lid is turned out to a normal position and the wound is closed. By varying (1) the amount of skin re-

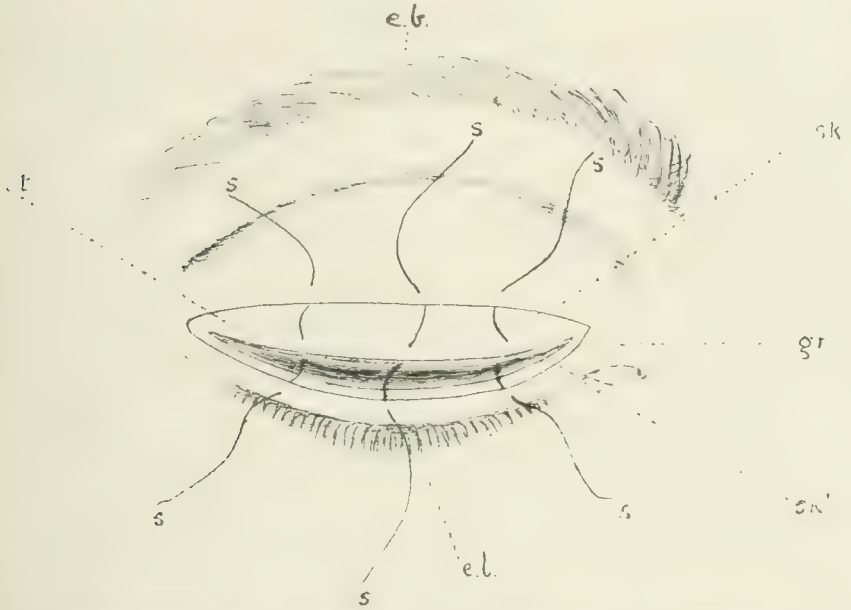

FIG. 73.—Operation for Entropion. *e.b.*, eyebrow; *e.l.*, eyelashes; *sk*, *sk*^{1}, margins of skin incision; *t*, tarsal plate, showing groove, *gr*; *ss*, *ss*, *ss*, sutures.

moved, (2) the depth and width of the wound in the cartilage, and (3) the exact placing of the sutures, the total effect of the operation can be controlled according to the demands of any individual case. The operation is also of much value in the treatment of trichiasis and distichiasis. In lesser degrees of the latter condition, the excision of the portion of skin carrying the offending cilia may suffice; it is often of value to transplant a piece of the buccal mucous membrane into the gap so formed, in order to prevent entropion. In simple cases electrolysis of the one or two offending hairs will remove the trouble.

In confirmed cases of pannus, *peritomy* is of great value: A strip of conjunctiva, 2 to 3 mm. in breadth, is excised round the limbus opposite the pannus, care being taken to remove the tissue right down to the sclera, and where deep blood vessels are seen, to score these across with sharp scissor points or to touch them with the point of a cautery. If necessary, the whole circle of peri-limbal conjunctiva should be removed.

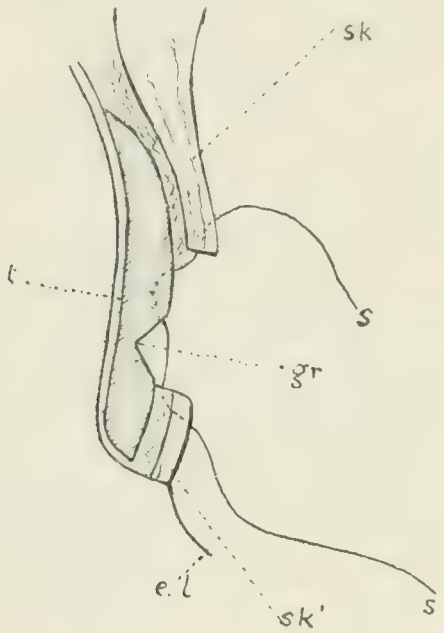

FIG. 74.—Operation for Entropion. *e.l.*, eyelashes; *sk*, *sk*[1], margins of skin incision; *t*, tarsal plate, showing groove, *gr*; *ss*, sutures.

Prophylaxis.—The patient should be warned that the secretions from his eye are infectious, and that he should not allow them to be carried to healthy eyes, by fingers, cloths, etc. The habit of using cosmetic pots that are common to a whole family, which may include several generations, probably helps to spread trachoma and other diseases in the East. Flies are a great danger, as they may carry discharge from the diseased to the healthy. Care should be taken to prevent their settling on inflamed eyes; cleaning the patient's face will do more in this direction than anything else. Every effort should be made to destroy the breeding grounds of these insects; the neighbourhood of houses should receive special attention.

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CHAPTER III

SOME COMPLICATIONS AND RESULTS OF TRACHOMA

It would not be possible, nor would it be consistent with the objects of this work, to enter into a text-book description of the various complications of trachoma and other forms of chronic conjunctivitis, but it seems advisable to direct the student's attention to certain points, which are but lightly dealt with in most manuals of ophthalmology. The author is conscious that the result of this treatment of the subject will be to give this and the following chapter a certain air of scrappiness. This seems unimportant in view of the aim of the work, which is to encourage the further investigation of the less-known tropical conditions, by pointing out to the reader the tracts which have been blazed through the jungle of our ignorance by the pioneers who have preceded him. No one has done better work in this department of ophthalmology than Herbert, and for this reason the author offers no apology for quoting him so fully and freely as he is about to do.

PANNUS

Herbert has studied trachomatous pannus, and has made an effort to classify the various conditions, which are met with in the East, and are included in the above common term. He distinguishes—(1) *An acutely progressive form*, in which the invading vessels lie superficial to Bowman's membrane, and are fed from the conjunctival trunks. The vascularised patches have a triangular form, with their base at the limbus; the corneal epithelium

stains widely with fluorescin, due to a diffuse inflammatory process; and the progress of the disease may be such as to lead to total disorganisation of the cornea. (2) *A less acute form* resembling the first in its general characters, but associated with much less damage to the epithelial covering

FIG. 75.—Pannus Carnosus. (Photo kindly furnished by Lt.-Col. H. Herbert.)

of the cornea. The zone of closely set, superficial, raised, vascular tissue spreads only in the vertical direction, and does not extend out to the sides of the cornea. (3) *The more common, chronic, trachomatous condition*, without defined margin, and with practically normal epithelium, in which the vascular invasion primarily lies beneath Bowman's membrane.

Any of the above may be complicated by the development of adenoid formations (*a*) in or on the damaged cornea, and (*b*) in the limbus. Those, which are found in the former situations, may occur either as discrete nodular elevations, or as a diffuse infiltration of the whole area of altered cornea ; in the latter case, the progressive thickening, combined with continued increase of vascularity, may result in the condition known as "pannus carnosus" (Fig. 75). In the cases which affect the limbus alone, it may sometimes be made out, according to Herbert, that the translucent rim is really composed of a line of separate follicle-like elevations.

PANNUS ULCERATION

This "occurs just within the margin of a sharply defined pannus," and is of the type of a marginal ring ulceration. Such ulcers have "a notable tendency to leave clear depressions, rather than to fill up and leave opacities ; not only are rounded facets thus formed, but also extensive grooves. . . . Occasionally, in old-standing pannus, the whole of the central cornea is uneven. The surface presents numerous small facets, but these are entirely without defined margins. . . . As rare additions to old pannus opacity, may be mentioned local surface thickenings, possibly of an epithelial nature."

The reader is referred to Herbert's original paper for further details of the interesting conditions, which have been only cursorily sketched above, the quotations being taken direct from that communication.

UPPER MARGINAL PITTING OF THE CORNEA

This is another condition of some interest, to which Herbert has drawn attention. In cases of mild chronic pannus, the advancing margin of the new formation may be "interrupted by a number of small sharply defined semicircular indentations," which, as the line of advance moves down, may eventually become islands, and stand out by virtue

of being less opaque than their surroundings. The shallow pits thus formed are more or less pigmented, and the pannus vessels, in their advancing course, pass down between them. The condition is not absolutely confined to pannus cases,

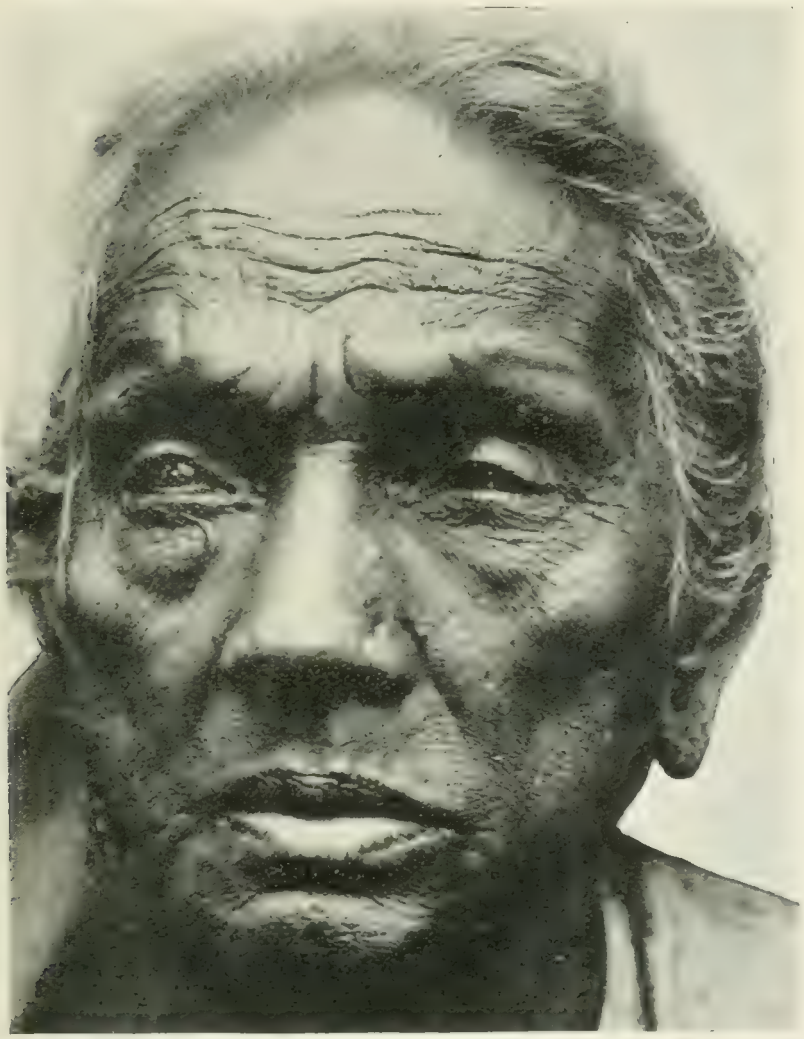

Fig. 76. -The Sinuous Lid Border. (Photo kindly furnished by Lt.-Col. H. Herbert.)

but is most frequently found in connection with them. Absorption of tissue in the pitted areas may markedly increase the depth of the pits.

REFERENCE

Herbert, H.—*Trans. Ophth. Soc. of U.K.*, 1904, vol. xxiv. pp. 67–77.

THE SINUOUS LID BORDER

(Herbert's Sign of Trachoma)

This sign is of sufficient interest to demand a short, separate notice. It consists of a distortion of the upper lid border, which is not uncommonly met with in tropical practice, and which Herbert believes to be almost exclusively produced by trachoma. "The inner portion of the lid margin arches upwards in a normal manner, but the outer half presents a curve with its convexity downwards. It (the distortion) is nearly always bilateral." Fig. 76 shows the condition well, but only on the left side; it will be observed that it is associated with marked ptosis, as indeed is always the case. In Herbert's experience this sign is confined to rather severe cases of trachoma with corneal complications. The distortion is not due to cicatricial contraction, as it may be well marked before any scarring has taken place. In early and active trachoma, there is more or less swelling of the lids, with infiltration and softening of the tarsus. The corneal complications give rise to blinking movements, which are exaggerated in force and frequency. Herbert thinks that this blepherospasm is largely instrumental in remoulding the softened tarsus; the reader is referred to the original reference for his explanation, which the author finds somewhat difficult to follow.

REFERENCE

Herbert, H.—*Trans. Ophth. Soc. of U.K.*, 1907, vol. xxvii. p. 38.

CHAPTER IV

SOME RESULTS OF VARIOUS FORMS OF CHRONIC CONJUNCTIVITIS

CONJUNCTIVAL BRIDGES AND POUCHES

Herbert has described certain, somewhat uncommon conditions under the above designations. These are among the rarer results of conjunctivitis, and particularly of trachoma. The bridges and pouches are most commonly found at the upper fornix, but may also occur at the lower. His explanation of their method of formation is as follows : During inflammatory attacks, swollen folds of conjunctiva descend from the loose retrotarsal membrane, as tongues of tissue, lying between the lid and the eyeball. These folds may contract adhesions, especially along their lower margins, to the tarsal conjunctiva, where they lie in contact with that membrane (Fig. 77). Herbert has seen two cases in which folds of conjunctiva were glued together by membranous exudation and bled when separated. The author has observed the same thing. Assuming such an adhesion to have once taken place, we can readily picture the later stages of the development of the condition ; when the inflammation subsides, the band of displaced conjunctiva will remain attached to the back of the tarsus, and will tend to assume a fan-shaped form, with its apex at the adhesion, and its wide base at the retrotarsal fold (Fig. 78). In some of the cases, several such bands occur, one beneath the other, the deepest being that first formed, and the others being of consecutively later date. A probe can sometimes be passed under the band from side to side ; in other cases, adhesions form between the deep surface of

the band and the underlying conjunctiva; these may greatly narrow the free space under the band, or may even shut it off into pockets, into which the probe only penetrates a short distance. It is conceivable that in some cases the whole depth of the band may adhere to the underlying conjunctiva, and that in this way all evidence of its existence may be completely lost.

These bridges and pouches are not very rare in tropical countries, but are not often

Fig. 77. — Diagram of a median vertical section of the eye and of the surrounding parts. It will be observed that a tongue of conjunctiva passes down from the retrotarsal region to be adherent to the back of the upper lid. It requires little imagination to understand from this diagram the formation of the conjunctival bridges and pouches described by Herbert. (Drawn by E. C. I. E.)

Fig. 78.—A conjunctival bridge. The lid has been everted to show a fold of conjunctiva springing from the retrotarsal folds to find a pointed attachment to the back of the tarsus. A probe is passed beneath the fold up to the line of the attachment. Below this fold are seen the normal folds of the retrotarsal conjunctiva from which it originated. Below these, again, lies the eye, showing the sclera, cornea, and pupil. (Drawn by E. C. I. E.)

seen, for the simple reason that a systematic search for them is rarely made. Moreover, they may very easily be overlooked, since the appearance of the folds

may not greatly differ from that of the membrane on which they lie.

The adhesions do not necessarily give rise to definite symptoms, but Herbert thinks that they may tend to keep up a slight conjunctival hyperæmia, by their drag on the lids.

Conjunctivitis in the Tropics is remarkable in several respects—(1) It includes a great deal of trachoma; (2) much of it is practically untreated; and (3) much of the treatment injures the parts unnecessarily, and would, in the interests of the eye, be much better dispensed with. The greater frequency of these conjunctival pouches and bridges, in tropical as compared with European practice, finds a ready explanation in the above stated facts.

Division of the bands, and subsequent movement of the lids, with a view to prevent their reattachment, is of service in a number of cases.

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CYSTS OF THE CONJUNCTIVA

Owing to the frequency with which inflammatory conditions of the conjunctiva occur in tropical countries, cysts of the membrane are relatively common.

Krause's glands furnish somewhat deep-seated retention cysts, which may lie in one or other fornix. Blocking of the ducts is presumably brought about by cicatricial contraction, following trachoma, or other chronic inflammations. The contents are often clear, and the cysts can, with care, be dissected out entire.

Henle's glands likewise furnish cysts, which are found in the fornices. They are, however, not true glands, but are simply due to folds in an inflamed conjunctiva becoming locally adherent; the cavities formed fill up with

mucous and serous fluids, and thus retention cysts originate. It is practically impossible to get these out entire, but if a careful dissection is made, and as much of the wall as possible is removed, a recurrence need rarely be feared.

Herbert has described a cyst formation, due to the downgrowth of epithelial tubules in conjunctivæ, thickened by chronic inflammation. The whole, or a large part, of the lymphoid portion of the upper tarsal membrane may become thickly studded with small cysts, due to the dilatation of these tubes. The contents of the cysts are yellowish and cheesy, or less commonly milk-like. The cysts appear as small points up to the size of a pin's head or larger. Their contents result largely from the accumulation and degeneration of epithelial and wandering cells within the tubes. If the cells, which line the cysts, are rich in goblet cells, the contents are more fluid in character. The membranes, which exhibit this extraordinary development of cysts, usually present a smooth, shining surface, free from evidence of active inflammation, but testifying by scars to the troubles of past days. Usually both eyes are affected, but the degree of affection varies greatly in different cases. Those who are interested in the subject are referred to Herbert's paper.

REFERENCE

HERBERT, H.—*Trans. Ophth. Soc. of U.K.*, 1899, vol. xix. pp. 22 and 23.

ESSENTIAL SHRINKING OF THE CONJUNCTIVA

Under this extremely unsatisfactory heading, we must describe a condition, which is by no means infrequently met with in tropical out-patient rooms, and which consists essentially in the obliteration of the fornices. It is not a question of the adhesion of the palpebral and ocular portions of the conjunctiva to each other, but rather of the gradual shrinkage of the subconjunctival tissues, accompanied by a similar shrinkage of the conjunctiva itself. The natural folds of the fornices are filled up, as it were,

from below, whilst the atrophying mucous membrane does not tend to be thrown into folds, but rather to take the shortest possible line from the lid edge to the eyeball (Figs. 70 and 71). In this way, the lower fornix may be almost completely obliterated, whilst the upper one is greatly shallowed. The conjunctiva, and often the cornea, are xerotic, and vision may be greatly interfered with. A history of very prolonged conjunctival inflammation can always be obtained from the patient, and it is often quite obvious that the trouble began in trachoma. Treatment is very unsatisfactory.

CHAPTER V

PARINAUD'S CONJUNCTIVITIS

This disease was first observed by Parinaud in 1892. It almost always attacks only one eye. It is accompanied by severe constitutional disturbance, and the preauricular and cervical glands are often swollen and painful. The conjunctiva is acutely inflamed, and reddish-yellow granulations form, not only in the retrotarsal folds, but also on other parts of the mucous membrane, inclusive of that covering the eyeball. Quite large swellings may thus be formed. In addition, the membrane not infrequently shows a number of small, superficial, sloughy ulcers. Secretion from the eye is scanty and mucoid. Pain is usually slight. The lids are somewhat swollen Several of Parinaud's cases occurred in butchers, or in other people associated with cattle, thus leading him to suggest an animal origin for the disease. Doyne thought he could trace a connection with mangy cats and dogs. Streptococci have not infrequently been found in the secretion from the eye, and have been accused by many of being the causative agent of the disease. This view has not, however, found universal acceptance.

Stratford has seen a disease similar, if not identical, with Parinaud's conjunctivitis among the coolies employed in the tea-gardens of Upper Assam, and has also met with cases among Europeans in the same district. Age had no influence on the incidence of the affection. He suggested that contagion might pass to human beings from the native dogs, many of which suffered from mange. He observed that the disease was more prevalent at the beginning of the rainy season—that is to say, at a time when insects are most

numerous and most troublesome, and he thought that this point should be borne in mind in studying the ætiology of the condition.

The disease usually ends in recovery after a few weeks or months, but serious complications may occur, not the least formidable of which is a severe iritis or irido-cyclitis, and the suppuration of the affected glands.

The only conditions with which this disease may be confounded are trachoma and tuberculosis. With care, mistakes of this nature should be rare. The use of test injections of tuberculin under the skin, might at times be very valuable.

Treatment.—Many drugs have been advocated, and of them all argyrol would appear to be the most useful. Large granulating masses may be excised, or scraped, or even treated with the galvanocautery. If abscesses form in the glands, they should, of course, be opened.

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Stratford, H. M.—*Lancet*, London, October 15, 1904.

CHAPTER VI

SAMOAN CONJUNCTIVITIS

It seems probable that several diseases have been included under this somewhat vague appellation. We are indebted to Dr. C. F. Ely, a surgeon of the American Navy, for much of our information on the subject, which he has gathered from a number of sources.

In one type it appears as an **acute conjunctivitis**. The disease is infectious, and its onset is rapid. There is severe pain, marked photophobia, and every evidence of an acute conjunctival inflammation, which rapidly becomes purulent, and tends to bring about destruction of the cornea over varying and sometimes large areas. A distinct micrococcus is present in the discharge, often in pure culture; this is about 0·6 to 0·8 μ in diameter; it often appears as a diplococcus, and then closely resembles the gonococcus; it is easily stained, is Gram-negative, and grows readily on artificial media, either at the temperature of a warm room, or at that of the body; if kept moist, it retains its vitality for months.

The disease is prevalent throughout the entire Samoan group; it would appear to have been endemic beyond the memory of man, but it is stated to have become much more prevalent ever since the severe epidemic of measles from which the Samoans suffered in 1893: it may occur at any age, but is rare in young babies and in the aged.

The incubation period is from 18 to 36 hours. Corneal complications are frequent, and, in neglected cases, iritis and the formation of staphylomata are not uncommon. It is suggested that the disease is distinct from the types of conjunctivitis with which we

are familiar elsewhere, but it may be permissible to suggest that further investigation is called for, before we make up our minds on this point.

The treatment consists in the use of one or other of the silver preparations. It is specially claimed that protargol gives early and excellent results.

There is another, and apparently quite distinct type of affection, which is spoken of as a **chronic eyelid disease,** and which is stated to be widely prevalent in Samoa. So much difference of opinion exists as to the ætiology of this condition, that we must await the results of further investigation, before attempting to decide whether it is a late stage of the acute conjunctivitis above described, or a form of trachoma, or, though this is unlikely, a disease *sui generis.*

REFERENCE

Ely, C. F.—*Ophth. Rec.*, September 1914.

CHAPTER VII

SPRING CATARRH

This disease, which is admittedly rare in England, is by no means uncommonly met with in Indian eye clinics. In the East, as in the West, it shows a marked preference for young people, and assumes a distinctly milder type when seen in those of more advanced age. It is probably of very rare occurrence after 40, and is a comparatively infrequent condition in females. All races are subject to attack in the Tropics. The greatest prevalence is in the wet weather, and the least in the hot weather.

Symptoms.—Itching of the eyes is severe, and leads to a constant rubbing of the lids, which attracts the attention of the patient's relatives. As in European cases, the disease may attack the tarsal conjunctiva, or the limbus or both. Herbert lays stress on the fact that many cases of *tarsal spring catarrh* are overlooked, owing to the failure to recognise the milder types of the disease. In these, the tarsal conjunctiva may merely be slightly injected, or may show a fine papillary roughness, with slight thickening and loss of transparency, and with or without the presence of small, scattered, pale, follicle-like elevations. Typical cases are, however, not uncommon. In these the whole of the tarsal conjunctiva of the upper lid is replaced by a mass of hard, flattened, pale-pink granulations, which are so closely aggregated, as to give rise to a characteristic tesselated, or mosaic-like appearance (Fig. 79). In some cases, the granulations are feebly pedunculated. The conjunctiva, covering the parts affected by spring catarrh, has a characteristic, milky-white, opalescent appearance. A most important point is that the follicles

are absent from, or at the most very scantily represented in, the lower fornix. There is practically no discharge from the eyes in cases of this disease. Contrast Figs. 79 and 80.

Fig. 79.—Spring Catarrh. Photo kindly furnished by Lt.-Col. H. Herbert.)

Similarly, when the disease affects the bulbar conjunctiva, great variations are observed in its severity and in the extent of the tissue attacked. The part invaded is the limbus, and the invasion may affect a part or the whole of the circumference of the cornea (Fig. 81). Again, the new-

formed tissue may be so slight as merely to resemble an exaggerated arcus senilis, or may implicate a large portion of the cornea, and even interfere with vision. Owing to a drooping of the eyelids, the patient may have a sleepy look. Herbert has pointed out that if fluorescin is used in these cases, a number of brightly stained points are seen

Fig. 80.—Trachoma. (Photo kindly furnished by Lt.-Col. H. Herbert.)

in the limbal thickening. Sometimes we find in addition buried, buff-coloured, stained dots, produced by the stain colouring the contents of minute epithelial vesicles, which are found in the substance of the tissues. For the satisfactory observation of these staining phenomena, it is essential to use a magnifying loupe.

An increase of eosinophiles is observed in the blood of

these patients up to 10 per cent., or even up to 20 per cent. of the total leucocytes in some cases; often, however, the increase is quite small (Herbert).

Diagnosis.—Herbert has pointed out a very valuable means of arriving at a positive diagnosis in the slighter

Fig. 81.—Spring Catarrh, affecting the bulbar conjunctiva. (Photo kindly furnished by Lt.-Col. H. Herbert.)

cases of spring catarrh. If the mucous membrane covering the diseased part is exposed to slight injury, a scanty, thin, filmy exudate makes its way on to the surface, and in this discharge enormous numbers of eosinophiles are found very irregularly distributed. He considers that the best way to apply this test is to evert the lid, and to keep the tarsal mucous membrane exposed to the air for about a minute;

ten minutes later the lid is again everted, and the exudate is removed, is stained with eosin, and then very lightly counter-stained with weak methylene blue.

Treatment.—It must be confessed that this is very unsatisfactory. Adrenalin chloride has been much vaunted in some cases as a local application, and most of the drugs used for conjunctivitis have been tried with varying results. Protection of the eyes from light, and from wind and dust by the use of gauze-sided goggles, glazed with Crookes' B glass, is an obvious indication. Arsenic and quinine have been given internally. These and many other measures probably owe their reputation to the tendency the disease has to subside as the climatic conditions alter. The plain lesson from this is to get the patient into a more favourable climate, whenever it is possible to do so. With Europeans a voyage home is indicated.

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CHAPTER VIII

FILARIAL CONJUNCTIVITIS

According to Edward Jackson, the description of a supposed filarial disease, affecting the conjunctiva in children in Mexico and Central America, varies so widely from most descriptions of filarial disease, and is so indefinite as regards the organism responsible, that we must accept the existence of such a condition with reserve.

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CHAPTER IX

A DISTINCTIVE CONJUNCTIVAL PAPULE

(H. Herbert)

Under the above not very satisfactory or euphonious name, Herbert has described, what he holds to be a distinct clinical entity, which is probably not uncommonly to be met with in tropical practice out East, but which would appear to be comparatively rare in Western experience. The author can support Herbert's statement that the condition is met with elsewhere than in Bombay, for he certainly saw it in Madras.

Clinical Features.—The papule appears without any apparent exciting cause, and is always situate on the exposed inter-palpebral portion of the conjunctiva. It is only met with in adults ; it is, according to Herbert, more than four times as common in males as in females, though this is probably a question of exposure ; it shows no seasonal prevalence, and so is presumably not due to any climatic influence. Solitary and painless, it is most often seen to the inner side of the cornea ; it differs from a pinguecula in being more elevated, more prominent, and more sharply defined. Its diameter ranges up to 5 mm. The colour is pale pink to nearly white, but with no trace of pingueculous yellow in it ; it stands out from the surrounding injected conjunctiva by its greater pallor ; the latter recalls that of spring catarrh, and is indeed due to the same cause, namely, epithelial thickening. Whiter points may often be seen as a result of the formation of small vesicles in the epithelium. The surface may stain feebly with fluorescin, but does not usually do so. Occasionally tortuous vessels may be made out with the aid of a loupe.

The unaffected portions of the interpalpebral conjunctivæ of both eyes usually show some change—either pingueculous thickening or scarring from past trouble.

Pathology.—Herbert gives the following as the chief histological features of the affection—(1) Considerable epithelial proliferation; (2) more or less inflammatory infiltration; and (3) elastic tissue degeneration.

Those who are interested in the matter are referred to Herbert's original papers, especially the second.

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CHAPTER X

MISCELLANEOUS

Argyrosis. — This condition is very commonly met with in tropical countries, as a result of the long-continued use of one or other preparation of silver, in the treatment of chronic affections of the conjunctiva. The claim has, from time to time, been made on behalf of one or another of these preparations that they do not stain the conjunctiva. Such pretensions are not founded on fact. It is much more difficult to guard against argyrosis in Eastern than in Western practice. The surgeon must keep the danger constantly in mind, and endeavour to substitute non-staining application whenever possible, especially when he is dealing with fair people. It must not be forgotten that the protracted use of copper sulphate also causes a well-marked staining of the conjunctiva.

Foreign Bodies in the Conjunctival Cul-de-Sac. — Very large pieces of wood or other substances are sometimes found in the upper cul-de-sac in Eastern practice. Sometimes these have been put there deliberately, but more often they are the result of accidents, and especially of running into tree-branches at night, whilst walking about in the dark. It is a safe rule in doubtful cases in children to examine for such bodies under a general anæsthetic.

Tears of the Conjunctiva and Lids by Cows' Horns. — The frequency with which such injuries are met with is surprising, but it is explained by the intimacy between men and cattle; it is no uncommon thing in the East to see cows within the houses.

PART II

DISEASES OF THE CORNEA

CHAPTER I

SUPERFICIAL PUNCTATE KERATITIS

This condition is very prevalent in Eastern countries, and from time to time appears there in an epidemic form. From the descriptions given by very reliable observers, it appears certain that several, and possibly many, quite distinct diseases are included under this common term. Unfortunately, the available literature is still very scanty, and there are evidently large gaps in our knowledge. Under these circumstances, it would seem that the best course to pursue is to draw attention to those forms of which we have clear descriptions, in the hope that, in the light of the information so obtained, others will be encouraged to undertake systematic research, both at the bedside and in the laboratory. If they will only do so, we may confidently look forward to the arrival at a wider, better, and clearer understanding of the whole subject. The practice of naming a disease after its discoverer has been widely, and perhaps not altogether justifiably, condemned. However that may be, it has been decided to risk such criticism in the present instance, and that for a double reason—(1) It would be difficult at the present stage to find other suitable names for these conditions, so alike and yet possibly so diverse ; and (2) it would seem not inappropriate to give credit for fine pioneer work to the men who have had the insight and the imagination to realise clinical entities, where so many of us passed them by. Genius in medicine, as in

other subjects, often lies in the appreciation and in the interpretation of small things. No further explanation will therefore be offered for describing the conditions that follow under the names of those to whom we are indebted for our knowledge of the subject.

HERBERT'S DISEASE

Herbert described an epidemic which occurred in Bombay in 1900. It was first noticed about the close of the rainy season, and increased in intensity during the cold weather, dying away in the hot months.

The spots on the cornea were minute, and easily escaped attention until stained with fluorescin ; they were slightly elevated and, on careful inspection, the cornea could be seen to be a little ruffled by their presence. When the surface was partly dried by exposure, some of the dots could be seen as small elevations, others as shallow pits. Occasionally the limbus was affected, and, more rarely, the upper tarsal conjunctiva showed implication. Toward the close of a case, the eruption was limited to the centre of the cornea, and the affected space steadily diminished in area. Where the dots were very numerous, Herbert stated that " they were often mostly collected into a boundary zone—broader horizontally than vertically, and situated nearer the lower than the upper margin of the cornea." Sometimes a patch of the cornea showed a rounded or linear fluorescin stain, after the dots had apparently healed. The curious point about this area was, that it changed its position from day to day. As a rule, the limbus was thickened, and showed moderate ciliary and conjunctival injection ; the accompanying conjunctivitis varied much both in intensity and in character. Towards the end of a case, a formation of small follicles might be noticed along the upper border, and at the two ends of the upper tarsus. Occasionally, the signs and symptoms were so mild that the condition might easily have been overlooked but for the use of fluorescin, and yet this stain might reveal a copious corneal eruption. One of the most striking features of the

disease was its almost invariable limitation to one eye. It did not appear to spread in families, or to be directly communicable ; it was not associated with nasal catarrh. In Herbert's experience, it was an affection chiefly of young adult life ; the decennial period from 20 to 30 furnished the largest number of cases, and over two-thirds of the whole fell between 20 and 40 years of age. It was not seen in young children, and was very rare after 50. There was no sex preference. The duration of the case was commonly from two to three weeks.

Herbert discovered a bacillus in the epithelial scrapings, which, he thought, was probably responsible for the condition ; it was enclosed within a very distinct capsule, and possessed feeble staining facilities. He was unable to grow the organism, or to transfer it by inoculation.

A similar condition was from time to time observed by the author in Madras, but unfortunately was not closely studied by him there. It is probable that a systematic examination, with the use of fluorescin, will reveal it as very widely scattered throughout the East. It is obvious that the affection is very liable to be overlooked, or to be set down to a mild conjunctivitis.

WESTHOFF'S DISEASE

Westhoff has contributed a paper on " Tropical punctate keratitis," as observed by him in Java among the workers in the wet rice-fields. Without conjunctival hyperæmia, or pericorneal injection, there appear in the superficial and middle layers of the cornea a great many cloudy specks, varying in size from that of a grain of sand to that of a pin's head. The epithelium over the surface spots may be disturbed, but *fluorescin causes no staining* : the cornea looks like a culture plate with developing bacterial colonies. Photophobia is present, but disappears in about a week ; the minute cloudings of the cornea remain much longer. When ulceration occurs, corneal vascularisation is seen, but ulceration is not typical of the disease. It is noteworthy that the time of year of these epidemics corre-

sponds with that found by Herbert, in spite of the fact that, in obvious particulars, and especially in the absence of superficial ulceration, the two conditions differ from each other.

KIRKPATRICK'S DISEASE

Kirkpatrick has recently seen a large number of cases of "superficial punctate keratitis" in Madras. The epi-

FIG. 82.—Superficial punctate Keratitis, a form intermediate between Nos. 1 and 2. (Kirkpatrick.) (ex *Brit. Journ. Ophth.*)

demic began as it did in Herbert's and Westhoff's experience in the wet weather, but the trouble appears to be much more obstinate to treatment, and of a considerably longer duration, than it was in the experience of the other two observers. Kirkpatrick writes: "Up to date, we have been unable to find any causative organism; nor have we been able to find a cure for the condition. The deeper layers of the epithelium, Bowman's membrane, and the superficial layers of the *substantia propria*, all seem to be involved. The lack of irritation and congestion is an extra-

ordinary feature ; as a rule, the patient only becomes aware of the condition, when a spot forms in the pupillary area and so interferes with vision. There are three main forms —(1) Soft, small, discrete spots are scattered all over the cornea ; (2) a largish area is present with a raised ridge and a soft mass on each side, like a mutton-chop ; and (3) a soft-edged area, about 4 mm. in diameter, is discovered, generally placed under the shelter of the upper or lower lid (Figs. 82 and 83). None of these spots or patches stains with fluorescin, but, in the later stages, they often present a steamy surface." The most curious features are the marked epidemicity, the absence of any history or evidence of infection, the strong tendency of the course run to

Fig. 83.—Superficial punctate Keratitis. The three main forms are shown. (Kirkpatrick.) (ex *Brit. Journ. Ophth.*)

be chronic, the lack of irritation or of increased vascularity, and the absence of recognisable causative organisms. There does not appear to be any constitutional trouble associated with the condition. The disease has been met with in all classes alike : Coolies, servants, clerks, merchants, and Europeans of good station have been included in the list of those attacked.

Colonel Kirkpatrick sent one of his cases home to the writer. The patient was a young European merchant. The attack began with a patch of keratitis in the upper half of the left cornea. This was superficial and very dense ; it lay close to the limbus and was slightly vascularised therefrom. Two months later, on his arrival in England, there was a dense opacity in the left cornea ;

this had, in the meantime, involved the greater part of the thickness of the membrane, though the most superficial layers of all still appeared to be unaffected ; it was vascularised from above ; the tension was slightly raised in the affected eye. The patient had been using dionin, in combination with other rational treatment, but had only begun to make real strides in improvement after reaching a temperate climate ; there had been no other alteration of the conditions designed to cure the inflammation. The relief from tropical glare had been greatly appreciated by him. This, so far as Europeans are concerned, is the more important, as Kirkpatrick, after trying many different forms of treatment, had found one and all disappointing in results. Another point of special interest was that the inflammatory process, which had begun in the superficial layers of the cornea, had in this case spread backward to the deeper ones as the case ran its long-drawn-out course.

It will be clear that the disease, seen by Kirkpatrick, differs markedly from that described by Herbert and frequently observed by the writer in Madras ; indeed the two are probably quite distinct. Kirkpatrick's disease presumably has much closer affinities with that described by Westhoff, but there are obvious points of difference even between these two conditions.

Before leaving this subject, it seems right to direct the reader's attention to the condition which Luna has described as " keratitis punctata onchocercosa." This will be found dealt with in the chapter on onchocerciasis in Section V. Part II. Chapter V.

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CHAPTER II

FILAMENTARY KERATITIS

In Eastern countries, the rich bacterial flora of the conjunctival sac render it imperative that the surgeon should take very special precautions before he performs any major operation upon the eye. As a result of this, the irrigation of the conjunctival sac with perchloride of mercury lotion (1 in 3000) is widely practised by ophthalmic surgeons in India. One consequence of this measure is the production in quite a number of cases of the so-called " filamentary keratitis." The appearance is quite characteristic ; the small filaments can be seen like short threads, attached by one end to the cornea, whilst the other end hangs free. On irrigating the eye with normal saline solution, these little threads can be well demonstrated. It is probable that many other factors are capable of causing filamentary keratitis, but the condition is very rarely met with except after perchloride irrigation. Clinically, its occurrence is a matter of no importance ; after a few days the filaments fall off and the cornea clears up. Sometimes malingerers use corrosive sublimate lotion to produce an inflamed condition of the eye ; when in a doubtful case of this nature the filaments are seen, it is advisable to bear this point in mind, and to take steps to cut off the supply of the drug. Once the source of chemical irritation is removed, the cornea will rapidly clear up by itself ; but the cure may be hastened by the use of soothing treatment, such as the instillation of argyrol solution at intervals during the day.

Pathology.—This has been worked out by Bardelli by means of clinical and microscopic researches. According

to this writer, the corneal epithelium, under conditions of irritation, undergoes an abnormal proliferation at various spots; at each of these a bud is thus constituted; this becomes elevated and acquires a pedicle. The movements of the lids and of the globe bring about the torsion and elongation of this pedicle, by dragging upon the contiguous epithelial cells, which are more or less loosely attached to the deeper layers. In this way the filaments are formed.

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CHAPTER III

HERBERT'S CORNEAL PLAQUES

Herbert has found the following condition sufficiently often in India, to convince him that it should be recognised as a distinct clinical entity. One or more slightly raised, rough, grey patches are seen, close to the lower margin of the cornea, and usually extending quite up to that boundary (Fig. 84). These vary in opacity, and both they and the surrounding cornea are slightly vascularised. Both eyes are usually affected, but as a rule unevenly so. When the patches are multiple, they are seldom equally prominent.

Abnormal exposure of the cornea, due to defective closure of the lids, is frequently, but not invariably, to be noted in these cases. Scarring of the lids from old trachoma, the presence of the sinuous lid margin, and the results of badly conducted native operations are mentioned by Herbert as possible contributory influences. Some of the patients are feeble and ill-fed; the blinking movements of the lids are said to be frequent and incomplete. Conjunctival xerosis has been noted as an accompaniment of some of the cases. In nearly all of them, the palpebral conjunctiva is roughened or scarred, as the result of past conjunctivitis of one form or another, and Herbert is of opinion that there is a definite connection between the old inflammatory condition and the presence of these plaques.

It has been pointed out elsewhere in this book, that there are definite and well-defined causes of inferior corneal opacities, and that these are widely operative in India. Amongst such are to be numbered—(1) The scarring which follows exposure of the lower part of the cornea and of the neighbouring conjunctiva in patients, suffering from plague,

smallpox, and other severe fevers in Eastern lands. As has already been said, these people are only too often neglected; they lie on the dusty floor, with half-closed lids and eyes turned up, and no effort is made to protect the delicate exposed surfaces of the conjunctiva and cornea from dust, heat, draughts and insects. The result is that one finds them with these exposed surfaces hard and dry. The consequences can be imagined. Though the conjunctiva often recovers completely, the cornea is left permanently damaged. (2) The evil practice of putting

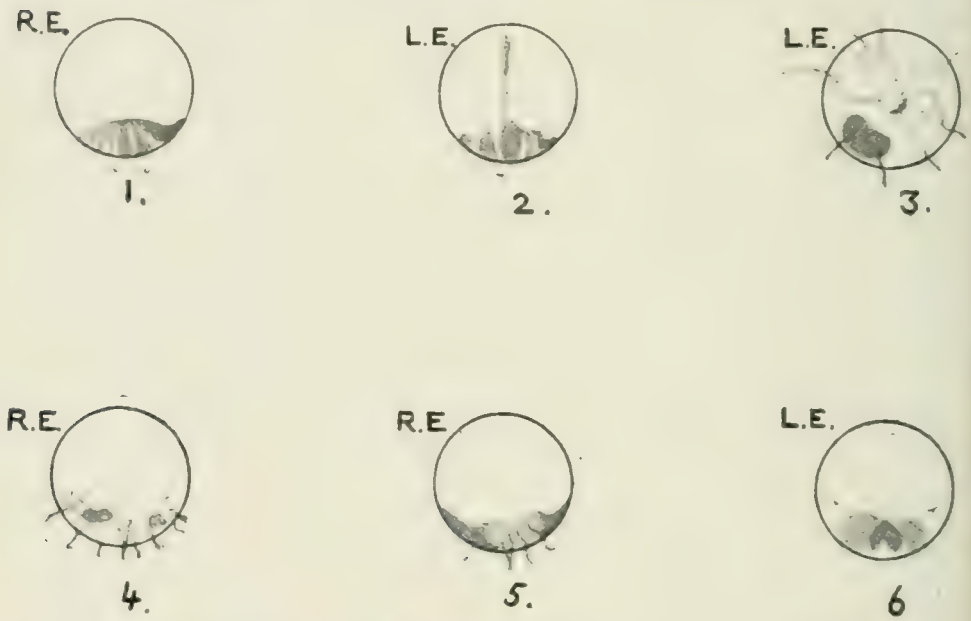

FIG. 84.—Herbert's Corneal Plaques, as illustrated by himself. He has kindly furnished the drawings.

irritant substances into the conjunctiva, either for the treatment of conjunctival affections, or with a view of restoring a comatose patient to consciousness, has already been described, and the attendant corneal scarring has been mentioned; as the drugs are usually placed under the lower lid, it is the inferior quadrant of the eye which suffers most; severe symblepheron may be thus produced. (3) The dangerous habit, common amongst the police, as well as amongst sepoys and other subordinate officials, of placing chunām[1]

[1] Chunām is a form of lime, used for whitewashing the walls of buildings in the East, and therefore readily available at all times.

under the lower lid, in order to excite a passing conjunctivitis, and so to evade an unpleasant duty, has also been descanted on, and it has been stated that the cornea is sometimes left permanently damaged by the malingerer unwittingly overdoing what he set out to do.

These facts are not mentioned in any criticism of Herbert's observations, but rather in expansion of them, and with a view to put the surgeon on his guard as to other possibilities in connection with appearances similar to those which Herbert has so interestingly described.

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CHAPTER IV

LEAD INCRUSTATION OF THE CORNEA

In countries where the standard of ophthalmic practice is low, as in the Tropics, the mistreatment of ulcers of the cornea by the application of lead drops is probably less rare than in Europe. On recovery of the patient, the resulting leucoma is intensely white and staring ; indeed, it gives the impression that a piece of white china has been let into the eye. Schiele has recommended that an attempt should be made to dissolve out the lead by the aid of nascent iodine, evolved by the interaction of 3 per cent. potassium iodide and 3 to 5 per cent. of iodine solution. The author obtained admirable results, in a very bad case of the kind, by flushing the surface of the eye with a strong aqueous solution of sulphuretted hydrogen, after first scraping the ulcer freely in order to obtain a raw surface ; the fluid was also freely dabbed on this area with wool swabs, thus prolonging the action. The intensely white patch at once turned brown, and remained so as long as the patient was kept under observation. The improvement in her appearance was very striking.

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CHAPTER V

SEPTIC ULCERATION OF THE CORNEA AND PANOPHTHALMITIS

We have had frequent occasion to speak of the common occurrence in the Eastern out-patient room of these two conditions ; indeed, it is out of proportion to anything of the kind as seen in a Western hospital, and that for two reasons, namely—(1) The rifeness of opportunities of infection, and (2) the want of care of eye injuries at an early stage. It is no unusual thing for a patient to make his first appearance with the sclerotic sloughing over large areas, and sometimes actually gangrenous.

Again, unless very strict precautions are taken (perchloride irrigation of the conjunctival sac, immediately before operations as discussed in Section VII. Chapter II.), suppuration will be found to haunt the major operation-wards, and especially the cataract cases. Such outbursts of post-operative panophthalmitis will, at certain seasons, assume an almost epidemic ferocity ; fortunately they can be easily controlled, if not eliminated, by the use of the precautions above indicated. The results obtained by cataract operators in the East are often explained by the better nature of the material ; this is a delusion. The dangers of sepsis, in India at least, are enormously greater than those which confront the British surgeon at home. How are we to explain this prevalence of sepsis ? The filthy habits of Eastern peoples have been cited in reply. It is true that the nails of the children are usually extremely dirty, that fæcal dust hangs in the air for a large part of the year, that the water used for washing is often indescribably contaminated, and that the habits of the people are, in

many respects, such as to render a detailed description of them undesirable, even in a scientific work ; but, all the same, the author believes that two conditions outweigh all others in the ætiology of ophthalmic sepsis, namely—(1) A longstanding infective condition of the conjunctiva, and (2) a like condition of an obstructed lachrymal sac. In other words, it is not the fragments of stone or metal that infect the eyes of the masons, the fitters, the metal workers and others ; nor is it the pointed blades of grass or the ears of rice or grain, or the thorns in the jungle by night, that stab-culture the cornea or the conjunctiva of the ryot. The real fact is that the virus lies already in position, only waiting for some sharp instrument, whether sterile or septic, to make the necessary wound for its implantation in the tissues ; the movements of the lids do the rest.

Whilst on this subject, there are a few minor points that deserve a passing mention: Panophthalmitis, or even septic keratitis, is extraordinarily rare following an iridectomy ; it is unusual after any of the operations for glaucoma, but, as already stated, it haunts the path of the cataract surgeon. How are we to account for this ? Is it a question of larger, and perhaps less smooth, incisions ? Is the more extensive opening up of the eye, and especially the exposure of the vitreous in the depth of the wound, an important factor ? Is the uveal tissue more injured and more widely laid open to sepsis? The impaction of iris in the wound can hardly be responsible, for, except in the work of skilled operators, it is far from unusual in iridectomies.

Then another point—Diphtheria of the eye is so uncommon in India that, in the whole of his experience, the author cannot recall to memory more than three instances of it. Still more remarkable is the absence of tetanus from the wards of the ophthalmic hospitals in the East, whilst the disease is an everyday occurrence in those of a general hospital. In all the years he spent in India, the author cannot recall even one solitary case of tetanus following any disease, injury, or operative wound of the eye.

Treatment.—Of the many methods for the treatment of

septic ulcer of the cornea, it is doubtful whether any can compare with the use of the actual cautery. It is not necessary to touch the surface with the heated metal; it is sufficient to hold it so near as to cause the surface to dry up thoroughly. A paracentesis with a narrow Graefe's knife should be added, especially when the chamber is full of pus. A dense, stringy, sloughy mass often escapes; if it does not do so, it can be easily delivered from its impacted position in the lips of the wound with the aid of a pair of iris forceps.

Evisceration of the Eye.—This is the operation of choice in all cases of panophthalmitis. Excision of the eyeball is dangerous in such cases, since it involves the extensive opening up of lymphatic spaces, whereby septic material may spread to, and infect the meninges with fatal results. The author was warned against this operation by his predecessor, but disregarded the advice and quite early lost a patient thereby. To appreciate the importance of the subject, it must be remembered how frequent panophthalmitis is in the practice of a surgeon in the East. Warned by this unfortunate experience, the writer never again excised a suppurating eye, but resorted always to evisceration, and in all the years that followed he never repeated the unfortunate experience of his first few months. The same sequence of events was followed in the practice of another, and a very distinguished ophthalmic surgeon, whom the author warned in the same terms as he had himself been cautioned. His advice was neglected with the loss of a patient under like conditions, and with the permanent conversion of the operator in question.

The steps of the procedure are very simple, and as it only takes from thirty to sixty seconds to do the whole thing, general anæsthesia under ethyl chloride suffices for the purpose. (1) With a sharp knife (a disused Graefe is excellent for the purpose) a short cut is made in the limbus; (2) with a pair of scissors curved on the flat, introduced through this opening, the whole disc of the cornea is rapidly excised; (3) the contents of the eye are removed with a spoon (Fig. 85), taking care to leave

no uveal tissue behind; the movement, which is quite a simple one, resembles that used when eating a boiled egg with a spoon; (4) the interior of the cavity is rapidly swabbed out with 1 per cent. biniodide solution on mounted swabs, and the cavity of the eyeball is then freely washed with a 1 in 3000 solution of the same drug. In cases where the sclerotic is sloughy, it will come away of itself after a while. From the moment that the patient comes to, his pain is relieved, and he need not be kept in

Fig. 85.—Elliot's Evisceration Spoon.

bed after the first few hours. A simple aseptic dressing is all that is required.

Colonel Kirkpatrick writes in the highest terms of the use of strong solutions of magnesium sulphate (from 30 grs. to the ounce up to concentration point) as an irrigation, as an eye-bath, and in the form of wet compresses in chemotic conditions of the eye. He has found this treatment of the greatest value in gonorrheal cases, and in threatening panophthalmitis with chemosis and proptosis. He says, "The pain disappears as a rule in a few hours, and the eye recedes with extraordinary rapidity. I use it pretty freely in septic ulcers too. It really is worth a trial." His advice may be confidently followed. One who witnessed the results of this form of treatment in the Madras clinic has described them to the author as "simply extraordinary."

PART III

DISEASES OF THE LIDS

CHAPTER I

A RARE FORM OF SUBCONJUNCTIVAL GRANULOMA MET WITH IN CENTRAL CHINA

P. L. McAll has recently described a condition, seen from time to time in Central China, in which the sight is obstructed, partly or entirely, by the formation of tumour-like masses which grow between the eyeball and the lid. It is not accompanied by conjunctivitis or other acute inflammation. The growths are painless; they do not ulcerate on the surface or break down in the centre, but remain firm throughout. The eyelids gradually undergo great thickening, which finally causes the mechanical occlusion of the palpebral aperture.

The patients are from fifteen to forty years of age, the majority being men. One or both eyes may be involved, the duration of the case ranging between one and a half and nine years.

The usual progress of a case is as follows: The growth commences as a rule near the inner canthus (rarely under the outer half of the upper lid), as a firm, fleshy thickening and protrusion of the conjunctiva; this protrusion is reddish in colour and not œdematous; it forms flat or rounded and nodular masses one-eighth to one-half inch in extent, which interfere with the accurate closure of the lids. The conjunctiva does not move on the surface of the growth, but is closely adherent to it. The growth spreads around the inner surface of the lids, involving the upper and lower fornices and making a heavy nodular cur-

tain between the eyeball and the lids (Fig. 86). With a probe one can make out a sulcus between the upper lid and the growth, and another sulcus between the growth and the eyeball (Fig. 87). In the case of the lower lid these sulci are less marked. The movements of the eyeball are still free, so that the cornea and the pupil can be seen moving behind and between the masses of the growth (Fig. 88). Later, the growth involves the ocular conjunctiva, causing some limitation of movement of the eyeball. It does not, however, invade the cornea or become adherent to it (Fig. 89). Still later, the palpebral conjunctiva is involved. The lid becomes greatly thickened, so that, viewed from the side, the palpebral mass bulges forward very markedly. The progress of the case suggests that the tissue beneath the conjunctival fornix hypertrophies and slowly pushes the conjunctiva before it, in the form of a fold between the globe and the lids, and that it later obliterates the fornix, causing the conjunctiva to stretch from the edge of the cornea direct on to the inner surface of the margin of the lid (Fig. 90). The palpebral conjunctiva may become everted to the extent of one-third of an inch near the margin of the lids and then shows a dry, atrophic, or eczematous condition. The growth of the tumour mass at the inner and outer canthi, combined with that along each lid, causes the palpebral aperture to be almost concentrically reduced, till in an extreme case it is represented by a tunnel about one-eighth of an inch across, leading down to the clear cornea (Fig. 91). This gets easily blocked by secretions or eczematous scales, and vision is lost. Movements of the eyeball are progressively interfered with, so that eventually a strong effort to move the globe results in a slight twitching of the palpebral mass, to which the globe has now become anchored. The skin is not infiltrated by the growth, but moves over it. The secretion of tears does not seem to be affected. In some cases only one lid is involved (Fig. 92).

The patients show no sign of syphilis, tubercle, leprosy, or other infection. There is no enlargement of the lymphatic glands, and the general health is unimpaired.

Fig. 86.—Subconjunctival Granuloma. A moderately severe case, showing flat and nodular masses between the eyes and the lids. (McAll.)

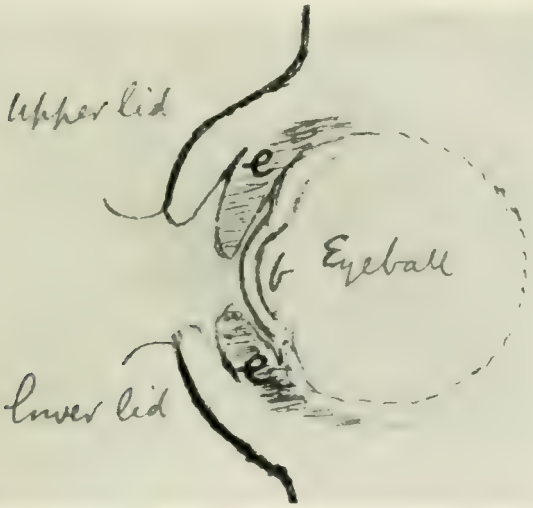

Fig. 87.—A diagrammatic section through the eyeball and lids, showing the curtain-like growths. *b*, the cornea ; *c*, *e*, the tumour masses. (McAll.)

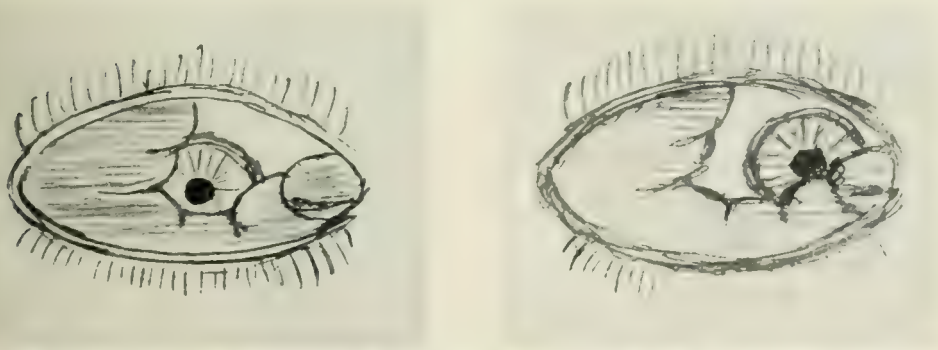

Fig. 88.—From the same case as Fig. 86, to show how far the eyeball could move behind the growths. Both are from the right eye. (McAll.)

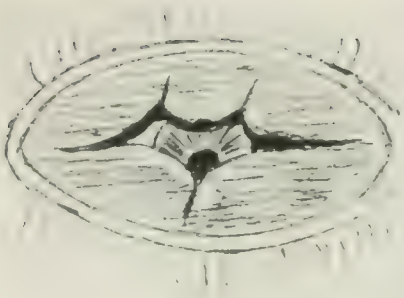

FIG. 89.—Drawing of a more advanced case, showing the tumour masses gradually spreading in front of the eyeball. (McAll.)

FIG. 90.—An advanced case, involving all the eyelids; duration, left eye 6 years, right eye 7 years. The dark central area in the palpebral aperture leads down to cornea. (McAll.)

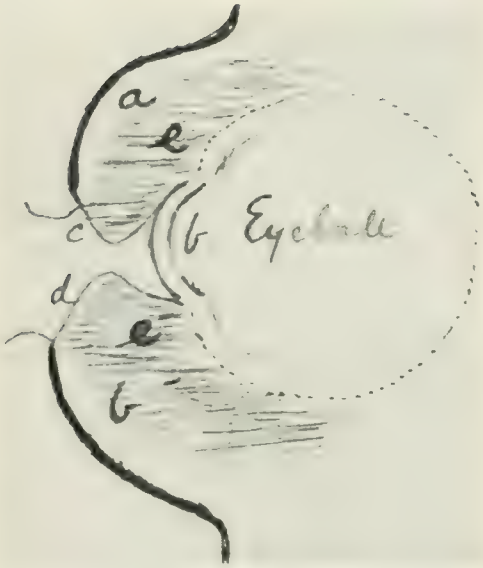

FIG. 91.—Diagrammatic section through eyeball in Fig. 90; *a*, *b*, upper and lower lids; *c*, *d*, everted conjunctiva; *f*, cornea; *e*, *e*, tumour masses. (McAll.)

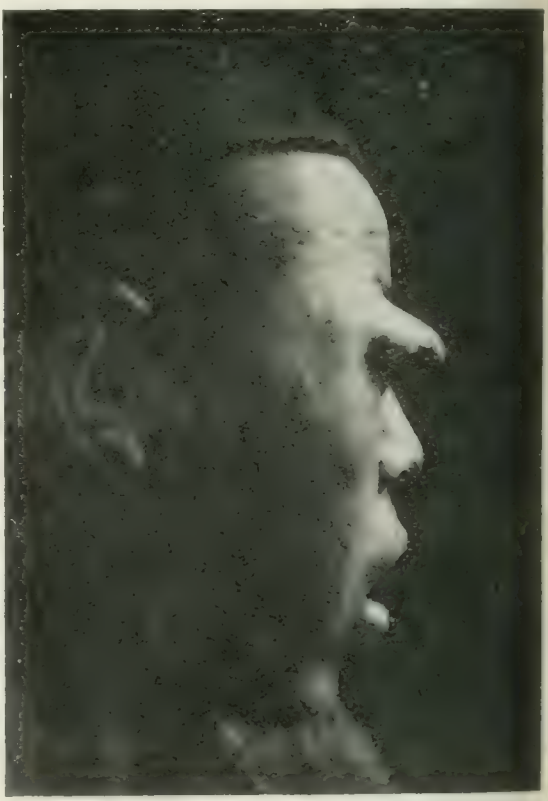

FIG. 92.—A rare type of the disease involving only one lid. (McAll.)

Note.—Figs. 86–92 are taken from the *British Journal of Ophthalmology*.

Some cases were operated on, and it was found that the growth was not encapsuled, but gradually merged into the surrounding tissue; it was intimately blended with the conjunctiva, so that the latter could not be stripped or dissected off it. The growth often extends backwards by the side of the eyeball into the orbit. In late cases it involves the tissue of the lids. The texture of the tumour tissue is for the most part firm but friable. In the palpebral region it is harder, almost cartilaginous. In no case could McAll feel reasonably sure of having removed all the diseased tissue. After operation the lids cicatrise, become indurated, and adhere to the globe. Recurrence occurs later, and then the lid becomes thicker and further infiltrated by the growth. Finally, if the cornea is no longer protected by the lid, it becomes dull and lustreless.

Under the microscope, sections of the tumour show that the bulk of the growth is composed of round cells (lymphocytes) which infiltrate the normal tissues: they involve the deep surface of the conjunctiva; the cells in the centre of the tumour show no sign of breaking down. The periphery of the tumour is fairly vascular, while the vessels in the centre of the growth have thickened walls. Up to the present no organisms or parasites have been found in the tissue, but the discovery of some such ætiologic factor may be confidently looked forward to.

The above description of this interesting condition has been given, as nearly as possible, in McAll's own words.

REFERENCE

McAll, P. L.—*Brit. Journ. Ophth.*, 1920, vol. iv. p. 20.

CHAPTER II

OTHER UNUSUAL THICKENED CONDITIONS OF THE LIDS

In Eastern practice, one meets from time to time with patients suffering from a very unusual lid condition. The author saw several of these during his service in Madras.

The whole lid becomes slowly increased in size, until it is many times as thick as it normally should be. The upper lid is affected most frequently and most severely, but both may suffer. There is evidence of past, long-standing, chronic inflammation of the conjunctiva; but active signs of inflammation may be altogether wanting, when the case presents itself for examination. The feel of the altered tissues is hard, to the point of being cartilaginous. On several occasions the skin was dissected off together with the cilia-bearing margin, and the mass of new tissue was cut away, leaving only the deepest layer with its conjunctival covering. In this way much of the unsightliness was relieved, and a good deal of the discomfort removed. The tissue cut as it felt, being of much the same consistence as the so-called tarsal cartilage. An examination of the masses thus removed, revealed considerable variation in different cases. In some, the pathological reports showed a dense mass of fibrous tissue, such as might have been expected from a long-continued chronic inflammation; in one there was pronounced myxomatous degeneration of the mass, whilst in another amyloid change was found. The last observation recalls the fact that Steiner, who worked in the Malay Peninsula, placed on record a case of amyloid degeneration of the conjunctiva and tarsus in both of the upper lids; this occurred in the course of a

severe trachoma with pannus in a Malay. The thickened tissue, in Steiner's case, corresponded to the tarsus ; masses of it were removed, and it was found that that structure had been replaced by amyloid material, the conjunctiva being also affected. The author is fully conscious of the scrappiness of these observations ; moreover, he does not think that these cases are of the same nature as those described by McAll, but he desires to draw attention to them in the hope that others, using better histological methods than he was able to avail himself of, may study these cases and settle their ætiology. The latter may possibly not be uniform. Amongst the factors of which account will have to be taken are syphilis, the presence of lardaceous disease elsewhere in the body, and a past history of trachoma. The subject is one of considerable interest, and should repay careful and systematic investigation.

REFERENCE

Steiner, L.—*Central. f. prakt. Augenh.*, Leipzig, February 1904.

PART IV

LACHRYMAL OBSTRUCTION

Although this condition cannot be described as peculiar to the Tropics, yet its prevalence in Eastern countries gives it a special claim on the attention of the practitioner in those lands. Some idea of the frequency of its occurrence may be gauged from the fact that 125 cases, many of them double, were operated on in the Madras Ophthalmic Hospital, for excision of the lachrymal sac in the year 1907, and the numbers were then rising. On not a few occasions it has fallen to the author's lot to run into double figures for this operation on a single morning.

Ætiology and Pathology.—Once the inflammatory process has started, the sequence of events is very obvious, and the chain can be followed through a chronic dacruocystitis to a gradually increasing obstruction at the lower end of the sac (the spot where this joins the nasal duct), culminating in the retention of fluid, and the distension of the sac thereby. Nor is it difficult to map out the later stages, for we know that the fluid, which thus collects, is an admirable medium for the growth both of pneumococcal and streptococcal organisms. Granted a breach on the surface of the cornea, the way is at once paved for septic ulceration of that membrane, with possibilities of wide destruction, of perforation, of anterior synechia, of adherent leucoma, and even of panophthalmitis and of phthisis bulbi. On the other hand, given a breach on the lining walls of the sac, whereby the streptococci, in rich cultures, may enter the tissues, and the onset of phlegmonous dacruocystitis is easily explained. It is the initial stage of the trouble

that is hardest to understand clearly. Why should chronic inflammation of the lachrymal sac be so extraordinarily common in Eastern practice? In seeking an answer to this question, we must emphasise the fact that the Madras experience is merely an index of what is taking place in the rest of the Orient. Many years ago the author sent home a number of sacs to the late Mr. George Coats, who submitted them to histological examination. His report showed two things—(1) That tubercle is not responsible for these cases, for in no single case did he find evidence thereof, and (2) that in a number of the specimens the sac-lining showed well-formed follicles. When one takes into account the great prevalence of trachoma in Southern India, and the frequency with which follicular enlargements, connected with inflammation of the post-nasal mucous membrane, are seen there, it seems not at all unlikely that this may be the key to the prevalence of lachrymal trouble in the south of India at least. In this connection it is of interest that Basso, who likewise worked in a country where trachoma is rife, found abundant evidence of that disease in the sacs he excised for "rebellious" cases of obstruction. Hertel, too, had noticed the existence of lymph-follicles in the removed sacs of certain cases of lachrymal obstruction as far back as 1899. On the other hand, Tooke of Montreal was unable to find evidence of follicular formation in his Canadian cases, and Kirkpatrick has been equally unsuccessful in Madras. The latter writer is disposed to explain the prevalence of lachrymal obstruction as a result of extension of trouble up from the nose, rather than down from the conjunctiva. The matter requires further investigation.

Statistics.—Some figures from our Madras statistics will probably be of interest to the reader, and the more so inasmuch as they probably are a fairly faithful representation of what holds for Oriental countries generally—(1) 65 per cent. of the cases are over 40 years of age, and only 8·5 per cent. are under 20. (2) Males and females are equally affected. (3) The right and left sides are equally affected. (4) All sections of the community are liable to

be attacked, but Europeans suffer very little; this last point is of interest, since trachoma is likewise rare in this class. (5) A history of past phlegmonous inflammation was obtained in 12·58 per cent., whilst 4·19 per cent. of the cases were seen in the acute phlegmonous stage; in 10·32 per cent. fistulæ were present; in over 19 per cent. there was an association of septic ulceration of the cornea with the lachrymal trouble. In over 55 per cent. the sac was dilated, and in some cases to a remarkable size, the swelling standing out like a large marble. Fig. 93 is a remarkable illustration of this point. In 62 per cent. the contents of the sac were purulent or muco-purulent.

A number of the patients belonged to dangerous trades, being fitters, goldsmiths, carpenters, stonemasons, road-metal breakers and so on. In all of the above and in many allied occupations, tiny chips of hard substance are apt to fly up into and injure the eye, thus tending to provoke septic ulceration of the cornea, provided that pneumococcal infection is present. Other similar sources of danger must not be forgotten. Many injuries of the eye occur in natives owing to their habit of walking about at night in the jungle without lights; it is by no means uncommon for the ryots (cultivators) to be pricked on the eye by the sharp points of the crops among which they work; many of the women get their eyes scratched by their children owing to carelessness, and the nails of these little people in the Orient are often very dirty and very septic.

Operative Measures.—The surgeon has the choice between extirpation of the sac, and one or other of the various methods, which have recently been devised for the establishment of a permanent passage from the lachrymal sac into the nose. The latter will not be dealt with, and this for several reasons: The operations are described in the modern text-books and elsewhere; they are procedures for the rhinologist rather than for the ophthalmologist; they are unsuitable for dealing with the large numbers of cases so often met with in the Tropics, inasmuch as they take a far longer time than extirpation does; and finally, it still remains to be proved that they give better results

in the long run. The last two points deserve a little further attention. In a tropical practice like that in Madras, where the author has been called upon to remove 13 sacs in a morning in addition to other operations, and has even then not completed the waiting list for that day, it is obvious

FIG. 93.—Lachrymal Obstruction with marked dilatation of sac on the right side.

that a quick operation is a very great advantage both to the staff and to the patients. It was found that on an average an extirpation would take from 5 to 10 minutes, the lower limit being more often approached; under favourable circumstances the records of $3\frac{1}{2}$ and $4\frac{1}{2}$ minutes from start to finish of the operation were attained. It

would certainly be impossible to do anything approaching this by West's or Toti's methods. Then as to the results—a very strenuous effort was made in Madras to follow up the extirpation cases, the aid of Government officials having been obtained for the purpose. There can be no doubt that in a very large percentage of the cases, great relief followed the operation. It will, of course, be admitted that a successful operation, which drains the contents of the lachrymal sac into the nose, which thereby gives the mucous lining of the lachrymal passages an opportunity to return to its normal condition, and which gives permanent results, is an ideal procedure; but anyone who has undertaken these operations under the difficult conditions prevailing in Eastern practice, will be quick to admit that there are a good many "ifs" in the above postulate. Be it carefully observed that we are speaking of practice under tropical conditions, and that these remarks are in no way designed to cover the possibly quite different conditions prevailing in Western practice.

What advantages can we claim for the patient, who has had his sac extirpated? Let us not forget that many of these people can probably never return to the hospital again, and that we must therefore aim at obtaining a permanent cure as speedily as possible. In any case we can rid the sufferer of two great dangers, since we can take away the ever-present risks of phlegmonous inflammation of the face and of septic ulcer of the cornea. More than that, we can, in a very large number of cases, greatly relieve the epiphora, which is so constant and troublesome a symptom of lachrymal obstruction, for the nervous supply of the gland, of the passages, and of the intermediate irrigated region (the cornea and conjunctiva) is from one and the same nerve (the fifth); it is therefore only natural that if we remove a source of constant irritation in the shape of the inflamed passages, we rid the whole lachrymal system of the previously existing irritation and excitation. Whether this explanation be right or wrong, one thing at least is certain, namely, that the extirpation of the sac is very frequently indeed followed by an immediate diminution of lachrymal

secretion ; in a large number of cases this happy result appears to be permanent.

Indications for Extirpation of the Sac.—In the presence of lachrymal obstruction due to dacruocystitis, the following indications may be enumerated :

1. Dilatation of the sac.
2. Purulence of the sac-contents.
3. Evidence of previous attacks of phlegmonous dacruocystitis, with persistence of the stricture.
4. A history of long-standing obstruction, combined with inability or unwillingness on the part of the patient to submit to a long course of probe-treatment, or with a timidity which renders it unlikely that such treatment will be persevered in.
5. The presence of any indication for an operation on the globe of the eye (especially cataract).
6. The presence of a septic ulcer in the eye of the same side.
7. Any factor, occupational or otherwise, which increases the liability of the patient to eye-injury. Not a few cases of septic ulcer of the cornea in Madras occurred amongst fitters, goldsmiths, and stonemasons.
8. The existence of double lachrymal obstruction, with evidence of past or present mischief in one cornea, is a strong indication for the removal of both sacs.

It would be almost easier to point out the indications for the old and conservative methods of dealing with lachrymal obstruction and dacruocystitis. They may be stated as follows :

(i) The absence of inflammatory or marked structural changes in the passages ; and

(ii) on the part of the subject, (*a*) the courage and patience to persevere through a long, tedious and painful course of treatment ; and (*b*) the means and leisure to give the necessary time required by the surgeon.

In other words, given an early simple case, in a man of means and leisure, we may adopt conservative treatment, always with the proviso, that failing success, we fall back on extirpation of the sac.

STEPS OF THE OPERATION

Preliminaries.—The operation is performed under chloroform, the patient being prepared in the usual way. Some surgeons prefer to operate under local anæsthesia. In either case, an injection of 3 minims of a 1 in 6000 solution of adrenalin chloride should be injected deeply

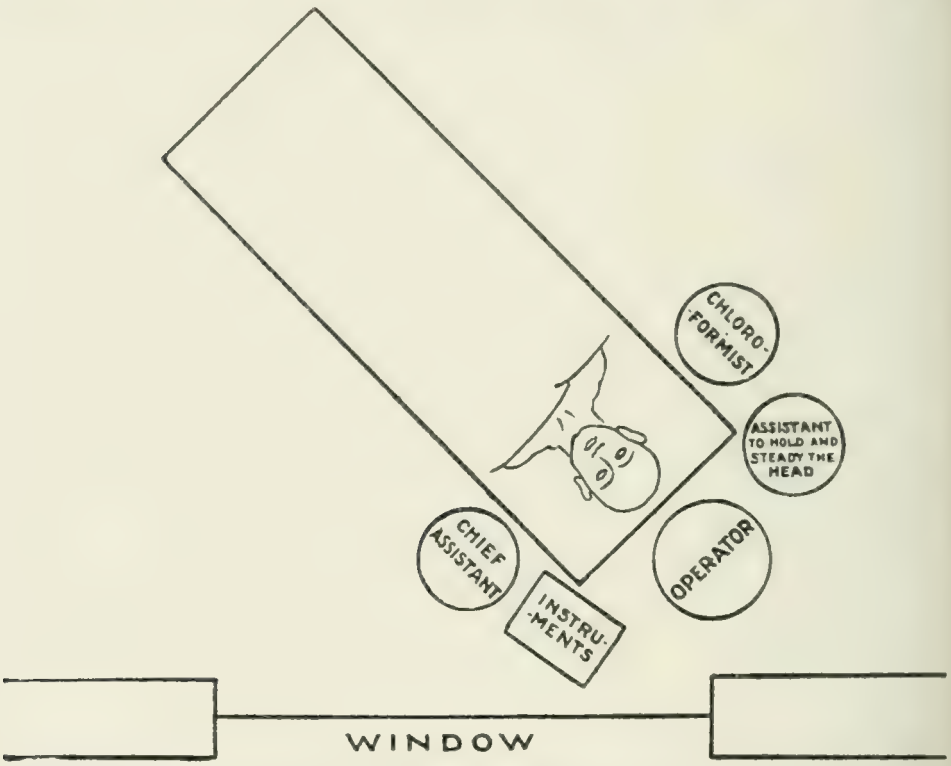

FIG. 94.—Diagram to show position of table, operator, assistants, etc., for extirpation of left Lachrymal Sac.

about five minutes before the operation starts. This greatly diminishes the hæmorrhage encountered, and so facilitates the steps of the procedure. The sac is squeezed dry of its contents, which are caught and removed on antiseptic swabs ; the face is painted with tincture of iodine in and around the operation-area.

The surgeon sits facing the patient's head as shown in the diagram (Fig. 94) ; the patient's head is towards the light, and his feet away from it ; but he is placed obliquely (according to the side), so that the light falls on and

illuminates the side of the face on which the operation is being performed. The position of the tray for instruments, of the assistant, etc., is shown in the diagram.

1. *Skin Incision.*—Define the internal palpebral ligament by pulling the lids outwards, and make the lower border of this the upper limit of the incision ; it is practically never necessary to divide this ligament, and it is most advisable not to do so, as when it is divided there is a risk of deformity after healing. Next, define with the finger the anterior lip of the lachrymal groove, and cut boldly down on to this, following its course, with a crescentic

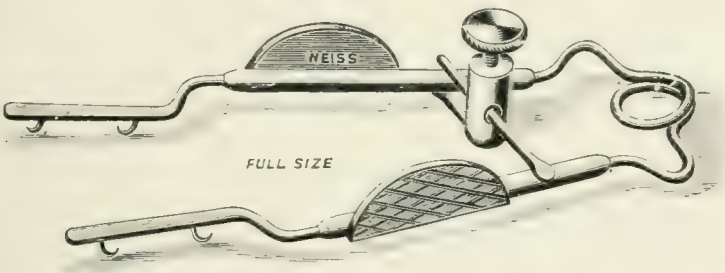

Fig. 95.—Müller's Retractor.

Fig. 96.—Elliot's Dissector for Extirpation of the Lachrymal Sac.

incision first downwards and then outwards. The average length of incision in 310 of the author's cases was 20 mm. Easy cases only required an incision 15 to 18 mm. long, whilst matted tissues demanded much more room (the maximum in any case being 27 mm.).

2. After separating the lips of the wound by the aid of a Müller's retractor (Fig. 95), define the layer of fascia which closes in the lachrymal groove, and divide this throughout the length of the skin incision. This may usually be done with the aid of a small sharp elevator (Fig. 96). With the same instrument, the sac is separated from the adjacent bone, internally and posteriorly. If not adherent, the sac may also be cleaned with the elevator on its outer side as well, up to the point of entrance of the canaliculi.

3. The dome of the sac is seized with a fine pair of forceps (conjunctival forceps do well) and drawn firmly downwards, whilst a pair of blunt-pointed scissors curved-on-the-flat, are used to free the dome from its upper attachments (working under the palpebral ligament for this purpose), to cut through the canaliculi, and to follow the sac down into the nasal duct ; this duct is divided as low as possible, the sac being pulled firmly up for the purpose. A pair of straight, fine, blunt-pointed scissors are often found more suitable than the curved ones for the final work in the nasal duct.

4. As large a probe as possible (Nos. 9 to 12 Theobald) is then thrust down the nasal duct, till stopped by the palate, pushing any mucous membrane in front of it ;

Fig. 97.—Spindle-shaped Cautery for the Nasal Duct.

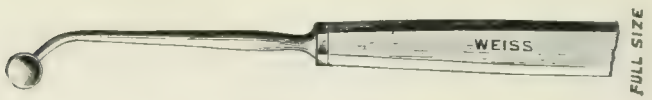

Fig. 98.—Ball-shaped Cautery for destroying any portions of the mucous membrane left in the dome of the wound.

a red-hot, spindle-shaped cautery (Fig. 97) is thrust boldly down the duct, to ensure the destruction of this membrane.

5. The cavity is dried and examined. The removed sac is carefully examined under water and slit open to make sure that no part has been left behind. If any portions have been so left, they are dissected out ; and if necessary the neighbourhood of the dome of the wound is cauterised freely with a ball-shaped, red-hot cautery (Fig. 98).

The cavity is freely flushed with a 1 in 3000 solution of biniodide of mercury, and the wound closed with three skin sutures. An aseptic pad and bandage closes the eye of the operated side, the other being left free.

The case is dressed on the seventh day, when the stitches are removed and the eye is released.

Hæmorrhage is dealt with by means of pressure and the use of adrenalin chloride solution. Any troublesome bleeding point is touched with the red-hot cautery. For pressure the author has always used sterilised swabs of cotton wool mounted on sticks 4 inches long, and about $\frac{1}{10}$ inch in diameter (*vide* Section VII. Chapter III.).

When the case is complicated by the presence of a septic ulcer of the cornea, the latter is dealt with at the same sitting. Of many methods tried, none gives such good results as the use of the red-hot cautery, brought near the eye but not into actual contact with it, combined with paracentesis of the chamber (*vide* Part II. Chapter V.). Such eyes are opened daily, and argyrol solution (1 in 8) is instilled; atropin or eserin are used as indicated.

Complications met with before Operation

1. Acute abscess of the lachrymal sac, with phlegmonous inflammation of the surrounding face.
2. Lachrymal fistula.
3. Ulcer of the cornea, especially of the septic type.
4. Cataract or other deep-seated disease of the eye.

(1) It is the custom in Madras to incise a lachrymal abscess freely, at the same time curetting its cavity, and sponging it out with a solution of perchloride of mercury (1 per cent.). When the inflammation has subsided, the sac can be removed; it is necessary to wait about a month, as a rule. In one case the author extirpated a sac within a few days of incision. The circumstances of the patient left no alternative, as otherwise she would have gone away and probably soon had a return of the severe inflammation when she was far from medical aid. As a routine measure such haste is inadvisable. (2) The presence of a lachrymal fistula need in no way deter the surgeon from operating. If the sac is cleanly removed and the walls of the fistula are scraped with a sharp spoon, primary union may be confidently expected. (3) The treatment of septic ulcer of the cornea has already been discussed. (4) In 27 per cent. of the Madras cases, the operation was under-

taken, with a view to render the subsequent extraction of a cataract safer. The latter operation can be undertaken one month after the sac has been extirpated.

Difficulties and Complications met with during Operation

1. The terminal branch of the facial artery should be avoided in the first incision, or it causes troublesome hæmorrhage. To this end, the lower border of the internal palpebral ligament should be made the upper limit of the incision, and in its whole extent the latter should be kept as near as possible to the inner canthus, and away from the nose.

2. When the lachrymal sac is not dilated or distended, it is not uncommonly bound down into the lachrymal groove by a dense fascia, which appears to be a backward reflection from the tendo palpebrarum. This fascia is often very dense ; further, when the bridge of the nose is high, and the orbits are consequently deep-set, the plane of this strong band of fascia comes to lie nearly parallel to the median sagittal plane. On the contrary, a low nose-bridge and a flattened type of face throw this fascial plane farther forwards on its outer side, *i.e.*, more into the plane of the face ; the obvious result of this latter conformation is to render the wound shallower and the sac more accessible. The former condition has naturally the opposite effect ; both the depth of the wound and the plane of the sac tend to embarrass the operator, who may easily burrow outward into the orbit, and mistake a lobule of fat for the sac. Such an accident need never happen, if after a first clean skin incision, the wound is held well open (by a speculum or otherwise), all hæmorrhage is stopped, the nasal margin of the lachrymal groove is well defined with the finger, and the dense fascia cleanly divided as close to this bony edge as possible. The sac is at once seen lying within its sheath of bone and fascia, and the operation can be proceeded with on the usual lines.

3. Hæmorrhage may be troublesome at three stages—

(1) After the skin incision, (2) after division of the deep fascia over the sac, or during separation of the sac ; and (3) from the nasal duct after the passage of the probe down its length. The first and second are most easily dealt with by firm pressure, aided if need be by a touch with a pointed cautery over any bleeding spot ; the last is best stopped by plugging the wound with a cotton-wool swab, in order to clean and dry it, and by then rapidly passing a spindle-shaped cautery down the passage, before it has time to bleed again.

4. When there has been preceding phlegmonous inflammation, and still more when there has been a long-standing fistula, the superficial structures are so matted as to be unrecognisable separately. It may even be difficult to recognise the sac itself. If one cuts boldly down on the anterior crest (naso-maxillary) of the lachrymal groove, and separates the sac from the bed of the groove with the elevator, it is not difficult to seize the thickened sac wall in the grip of a fixation forceps, and then to cut the sac boldly out with the surrounding structures, keeping as close to the former as possible.

5. When one desires to perform a cataract extraction, or other serious operation on the globe of the eye, and the lachrymal passages are found to be closed, even though there may be no very obvious retention, the writer thinks that it is safer to remove the sac, before undertaking the more serious intra-ocular operation. The patency of the passages can be tested by instilling a drop of argyrol into the conjunctival sac, and bidding the patient blow his nose strongly into a clean handkerchief. In this class of case it is common to meet with a shrivelled, contracted sac, which is tightly adherent to the surrounding parts. If so, the lachrymal groove is opened as usual, the elevator is used to free the sac on the inner and posterior aspects, and the head is then seized with forceps, and drawn downwards, whilst the body is separated snip by snip from the surrounding parts, some of which are necessarily taken with it. The same method is applicable to the cases where, though the sac can be easily defined anteriorly, internally and

posteriorly, it is yet adherent externally to the tissues in its neighbourhood, as the results of long-standing past inflammation. It is a question of operating by feel rather than, or at least more than, by sight ; and it is better to proceed boldly, and if any portion of the mucous membrane is left behind, to remove it after stopping all hæmorrhage, when the wound can be freely and well examined. The author makes it a rule to consider that, if the cavity does not look clean, or, in other words, if he is in doubt as to the thoroughness of the operation, the whole of the sac has *not* been removed. Nothing less than a thorough inspection of the wound should then suffice. A paraffin syringe was obtained for the Madras hospital in the earlier days of this operation, with a view to defining the limits of the sac in difficult cases. Before it had time to arrive, further experience had shown that it was always possible, granted a little perseverance, to extirpate any sac thoroughly. The troubles of paraffin injection were thus avoided, though it is conceivable that the use of this method would appeal to some, who have not the opportunity of doing many operations of the kind, and who might on this account be only right to use all possible aids. One cannot but think, however, that the difficulties of the operation have been overestimated, for out of 325 consecutive extirpations, performed in the Madras hospital during three and a half years, there was only one in which it was necessary to operate a second time on account of a portion of the sac wall having been left behind.

6. When there is extensive and deep ulceration of the cornea complicating the case, it is necessary to be most careful to avoid pressure on the globe during operation : as otherwise the eye may be ruptured with escape of its contents.

Complications met with after Operation.

1. Recurrence of retention, due to a portion of the sac wall having been left behind at the operation. This occurred only once.

2. Failure to obtain primary union of the wound, or breaking down of the same, after healing appeared to have been established. This occurred in only 2·66 per cent. of 150 consecutive cases, many of which were highly septic from the commencement.

3. Progress of the septic ulceration of the cornea, for which the operation was undertaken.

4. A chronic catarrhal condition of the lower lid, which is difficult to treat, but which eventually yields to patient treatment conducted along ordinary lines ; it is better not to be too active in this matter.

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SECTION IX

MISCELLANEOUS

Chapter I. Anatomical Peculiarities of Dark-skinned Races.

,, II. Glaucoma.
Optico-ciliary Neurectomy.

,, III. New Growths of the Eyeball and its Adnexa.

,, IV. The Correction of Errors of Refraction.

,, V. Opthalmoscopic Appearances in the Tropics.
(By Lieut.-Col. H. Kirkpatrick, I.M.S.)

,, VI. Hospital Management.
The Staff.
Administration.

CHAPTER I

ANATOMICAL PECULIARITIES OF DARK-SKINNED RACES

THE **ophthalmoscopic appearances** seen in dark-skinned people are peculiar. They will be more fully dealt with in the chapter contributed by Colonel Kirkpatrick (Chapter V. of this section). The native fundus requires a more intense illumination than that in "white people." The choroidal vessels are not seen, being hidden by the profuse and evenly distributed retinal pigment. There is often a ring of deep pigmentation surrounding the macula lutea. All varieties of fundus from that just described up to that usually found in fair races, are to be met with in dark peoples. If, for any reason, the retinal pigment is dissolved, the choroidal vessels stand out with remarkable clearness, their outlines being accentuated by the pigment masses lying between the individual vessels.

There is usually some amount of **pigmentation of the conjunctiva** in dark-skinned natives. This is especially well marked around the points of disappearance of the perforating vessels, and in the neighbourhood of the outer canthus. It may sometimes be so marked as to raise a suspicion of the presence of melanotic growth. This fear can easily be laid to rest, by the history of the duration of the appearance, given by the patient or by his friends. If a doubt remains, careful observation over a limited period will enable the surgeon to come to a definite conclusion.

The so-called **"obliquity of the eye"** in the Mongolian type, is not a real displacement of the organ, but is due to the development of a fold in the skin on the inner side of the upper eyelids; this fold imparts a false appearance of tilting to the eye.

The **nasal canal** in Europeans is comparatively long, narrow, and tortuous, thus predisposing the subjects to lachrymal troubles. The same holds good of many Oriental races, whose features closely resemble those of Europeans. Lachrymal obstruction is undoubtedly very common amongst Indians; this is presumably due to an extension of inflammatory processes along the lachrymal passages, in a land where conjunctival inflammations are extremely common. In the negro, on the other hand, the passage is wide and straight; this furnishes a ready explanation for the current belief that these people rarely suffer from lachrymal troubles.

CHAPTER II

GLAUCOMA

It is an extremely hard thing for a surgeon to form a correct conception of the relative frequency of such a disease as glaucoma in an Oriental country, and the difficulty will continue until the institutions for ophthalmic relief are widespread throughout the East. When there is but a single well-equipped eye hospital for a population of more than forty million people, it is obvious that such relief as is given only touches the fringe of the vast needs of the inhabitants. There are, however, certain features of Indian glaucoma statistics which cannot fail to strike any but the most careless observer, and if one may form an opinion from what one learns of the experience of others in Eastern lands, practically the same conditions prevail throughout the Orient. We shall take some of these features up in turn.

1. **The Relative Frequency of Glaucoma.**—In the Madras Eye Hospital, from 1909 to 1913, over 900 eyes were operated on by trephining for the relief of tension. This makes an average of over 225 per year, which would mean roughly that one eye was operated on for glaucoma for every 4 on which extraction of cataract was performed. These figures constitute a very wide divergence from what is found in Western statistics, and seem to indicate that, for some reason or reasons, glaucoma is relatively very common in the East. The fact that cataract is likewise believed to be common there only intensifies the impression so gained.

2. **The Types of Glaucoma met with in Tropical Practice.**—It is not only the frequency of glaucoma, compared with that of other diseases of the eye, which interests us ; we

must rank as of almost equal importance a study of the relative frequency of the different types of the disease to each other. Simple chronic glaucoma is extraordinarily common. Often the only symptoms are retraction of the field, cupping of the disc, and at a late stage, impairment of the central visual acuity. Not a sign or a symptom of congestion may be present, and the advance of the disease is often as unobtrusive as it is relentless.

Then as to the occurrence of acute or sub-acute glaucoma: If by these terms we understand the inclusion of acute and sub-acute exacerbations of chronic glaucoma, the conditions are far from infrequent in Oriental practice, not necessarily because of any great relative frequency, but rather because they constitute a not negligible percentage of the total cases of a disease, which figures so largely in Eastern practice.

3. **The late Stage at which Patients present themselves.**—Something has already been said about this. The poverty of the people, the apathy which so often has its roots in a lifelong struggle for a bare existence, the lack of ophthalmic hospitals, the long distances that have to be travelled, the ignorance of the people, and the campaign of slander conducted by the exponents of native surgery—these one and all contribute to delay the advent of the patients, until in many cases the disease has progressed too far for sight to be saved. Some idea of the true condition may be gathered from a limited investigation conducted at one time by the author: Of 172 patients, suffering from glaucoma, the vision at the time they first reported at the Madras hospital was perception of hand movements or less in nearly 40 per cent.; a further 24 per cent. could just count fingers, whilst the remaining 36 per cent. included all who could read Snellen's types at various distances.

From the point of view of operative prognosis, these are serious figures, but to gauge their lessons aright, we must look at the question from a much wider standpoint, namely, that of the modifications in diagnosis and in treatment imposed by such unusual conditions. We shall therefore make these points the subjects of the two following divisions of the subject.

4. **The Diagnosis of Glaucoma in the East.**—Owing to the late stage at which the patients present themselves, refinements in diagnosis are comparatively seldom called for. The nature of the trouble is written so large that even the student may read it. We do not have to return our patient to his practitioner with instructions to send him up from time to time for observation—he has no medical man, and he would not come back if bidden to, indeed he probably could not ; but there is no necessity to pursue any such course, for he has already waited until the diagnosis is more than assured. Then again, a large number of the patients are too uneducated to allow of perimetry being carried out with any prospect of its yielding good results. The average European can have but little idea of the difficulties which often attend any form of examination, calling for intelligent co-operation on the part of the patient. On the other hand, mechanical tonometry can be brought to a fine art, for assistants are plentiful and intelligent. and any surgeon can train one of them to use a Schiötz or a McLean as well as, if not better than, he can himself. In this way very valuable records can be obtained. Provided that types for the illiterate are used, the other methods of diagnosis can be carried out as they would be in Europe.

5. **The Methods of Treatment to be adopted.**—The surgeon cannot give a prescription for a meiotic, and keep his patient under observation, or have him so kept. Once the man leaves the hospital, he disappears into the void. and in the majority of cases is permanently lost sight of, so far as Western medicine is concerned. If therefore it is thought likely that operation will have to be resorted to sooner or later, it must usually be done at once. Even if the patient could afford, which he very seldom can, to return to the hospital when his symptoms get worse, the chances are greatly against his doing so, for he will argue. "I went to the hospital, they *did nothing* for me, it is not worth going again." Such is the interpretation he puts on the methods accepted as routine in a hospital in Europe. One more point : When we see a case in the British Isles with well-marked glaucoma in one eye, but with the other

hitherto unaffected, we should not dream of performing a prophylactic operation on the sound eye. Such a procedure would be unjustifiable ; instead, we warn the man of his dangers, and bid him seek expert assistance the moment any untoward symptoms arise ; and we do so with a confidence that he will obey us. Very different is the case with many patients in the Tropics. As we have already pointed out, they cannot return if they would, and they would not if they could, especially if we have been able to do comparatively little for the first eye. The argument that the second eye, if taken in time, can be saved, will often fall on deaf ears, for it will not be believed. But altogether apart from this, the length of the journey, the expense involved, and the difficulty of getting a friend to accompany him, will often make a second visit impossible. For these reasons, the tropical surgeon must entertain the advisability of prophylactic operations for glaucoma. It is not contended that he is to employ this method indiscriminately. Far from it! But he must weigh carefully the circumstances of each case, and decide it on its merits, conscious of the responsibilities that attend either action or inaction.

The present work does not afford a suitable opportunity for discussing the general subject of the treatment of glaucoma, whether operative or otherwise, but there is one observation which the author would wish to advance : The establishment of a large coloboma, such as that which follows the classical operation of iridectomy for high tension, has this grave disadvantage in the East, that it exposes the patient to very severe dazzling from a tropical sun. The glaucoma patient, at the best of times, and even under the most favourable conditions which follow one of the modern operations for the relief of tension, is always apt to be conscious, even in Europe, of the difficulty with which he adapts himself to changes in light and shade ; but when to this is added all the disadvantages of a large coloboma under a tropical sun, his complaints are both bitter and persistent.

6. **Glaucoma secondary to Cataract.** — This form of

glaucoma is comparatively rare in European countries. It is, however, very common in the East for the simple reason that the patients do not resort to surgical aid so freely as they do in countries, where the general standard of education is higher. The author has himself followed quite a number of such cases from an early stage of the cataract, and witnessed in them the onset of well-marked secondary glaucoma. Of these two stand out pre-eminent in his mind, as in both of them all vision was lost after an acute glaucomatous attack, although he had repeatedly and over a period of years advised both patients to submit to cataract extraction, and had pointed out to them the ever-present danger of an access of high tension. Both were well-educated men, and one was exceptionally intelligent. On a number of occasions, the onset of acute glaucoma has been witnessed in patients waiting at the Government Ophthalmic Hospital, Madras, for cataract extraction, in spite of the fact that these people had come in with apparently normal tension. In one period of 19 months, no less than 3 patients who had been admitted for primary cataract developed secondary glaucoma whilst under observation in hospital. In one of these, high tension came on within 24 hours, and in a second within 12 days of admission. In both of them the onset was presumably brought on by mental worry and anxiety in connection with the approach of the ordeal of operation. The third developed glaucoma 26 days after admission whilst under silver nitrate treatment for lid conditions.

To judge from the papers which have appeared in ophthalmic journals, many European surgeons have failed to make up their minds even as to the existence of this complication of cataract; on the other hand, the Madras out-patient room records show its occurrence in nearly 50 cases yearly. The appearance of the lens in these cases is characteristic of primary cataract, the history is unmistakable, and the existence of a primary, and hitherto uncomplicated, cataract in the opposite eye often clinches the diagnosis. At the best, the prognosis is a bad

one, especially when one takes into consideration the fact that the patients too often lose valuable time, after the onset of glaucoma, before they make up their minds to resort to European treatment. To extract the cataract at once is far too hazardous. The best practice is to perform an iridectomy, and to wait the settling down of the eye. When the globe has become quite quiet, extraction may safely be undertaken. This line of treatment is by no means unsatisfactory when the class of case is taken into account. But the necessarily large wound, both of cornea and iris, presents very distinct disadvantages as compared with that made in trephining. We shall return to this subject before the close of the next paragraph.

In the East, glaucoma secondary to cataract is not only of common occurrence, but it is also, not infrequently, of a very acute type. In this connection it is interesting to note several points, namely—(1) Glaucoma secondary to cataract is more than half as common again in females, as in males, in spite of the fact that many more males than females seek relief for cataract. (2) The period the cataract has lasted before glaucoma supervenes is always a protracted one, the complication resulting from continued neglect on the part of the patient to appeal to surgical interference, until long after the cataract is fit for extraction. (3) It is a point which it would not be advisable to labour, but statistics taken over 50 cases showed that the age of onset of glaucoma secondary to cataract is not above that at which cataract extraction is ordinarily performed in Madras. The inference would appear to be that two factors are at work, namely, an early onset and a long duration of the cataract. An important point of clinical interest is thus raised, for it is the intumescent type of cataract which in our experience is most commonly complicated by secondary glaucoma. This would apparently lend support to Priestley Smith's contention as to the influence of lens-swelling on the production of glaucoma. In a number of cases trephined in Madras for relief of this form of glaucoma, the results were excellent ; but in a few, the intumescent lens forced its way into the trephine hole.

its semi-fluid contents following the line of least resistance. For this reason trephining should be reserved for the class of case in which the lens is not semi-fluid, and in which no great forward movement of the lens and iris has occurred. It is more than doubtful whether it is sound practice to trephine when the lens is of the pearly-sectored, the intumescent, or the milky Morgagnian types.

7. **Blind painful Eyeball.**—This condition is commonly met with in India as a late result of congestive glaucoma, and attains an exceptional importance from the fact that many of the natives are very averse to parting with an eye. An operation, which relieves their pain, and which, at the same time, apparently leaves the organ intact, is therefore of great value to a surgeon who practises in the Orient. Such a procedure is to be found in optico-ciliary neurectomy.

OPTICO-CILIARY NEURECTOMY

This is far from being an easy procedure. Its real difficulties lie (1) in catching the nerve, without unduly disturbing the surrounding parts ; and (2) in dealing with the troublesome hæmorrhage which follows the nerve-section.

To meet the former, the author has had a special hook constructed. (Fig. 99.) It is of one piece of steel ; has a handle like a strabismus hook ; is 10 cms. long in the handle, and 5 cms. long in the blade. The latter presents at its end a large curve, which has been carefully moulded on the antero-posterior curve of an average eye, and corresponds to a little less than half the extent of such a curve. The extremity is bent back on itself 4 mm. on the plane of the curve (*vide* drawings). The mode of using it is simple. A large curved incision is made in the conjunctiva to the inner side of and concentric with the limbus, and lying over the insertion of the internal rectus muscle. The tendon of that muscle is then exposed and picked up in a pair of Prince's forceps. As soon as the internal rectus has been divided, the hook

is slid round the eyeball, to which purpose its large curve is obviously adapted, till the insertion of the optic nerve is passed ; a slight rotation of the axis of the handle brings

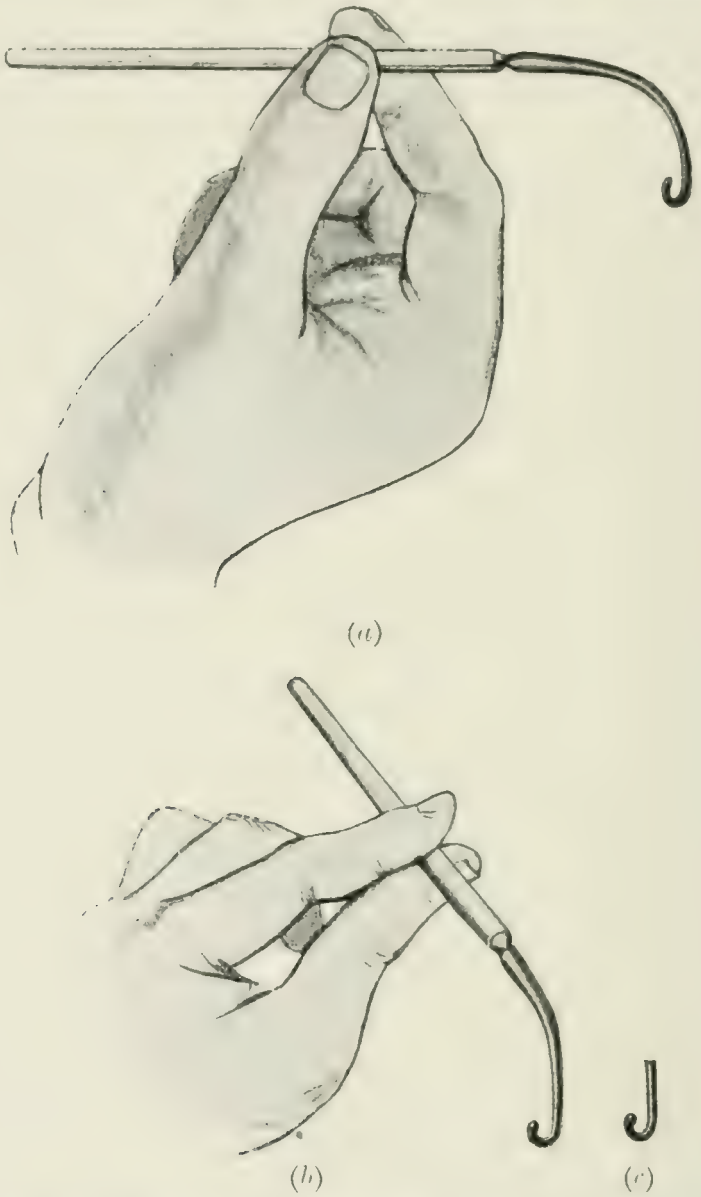

FIG. 99.—Elliot's Optico-Ciliary Neurectomy Hook. (*a*) Shown sideways. (*b*) Shown endways on, fore-shortened. (*c*) The end of the hook shown facing towards the observer.

the concavity of the hook opposite the nerve, which is at once caught, when the instrument is gently withdrawn a few mm. length. Whilst passing the hook, it is essential to have a firm hold on the eye, and to keep it in the axial

position, so that the exact position of the nerve insertion may be known. That the hook has engaged the nerve may be easily ascertained by the control over the eye movements the instrument at once possesses. A pair of scissors curved on the flat is now passed along the *convexity* of the hook, and the nerve is easily divided *proximally* to the instrument. At once the eyeball can be rotated till the optic nerve stump presents in the wound, and the nerve is then cut off close to the sclerotic ; the operation is completed in the usual way. If the hook be not used, there is often considerable difficulty in seizing the nerve ; but with it the manœuvre is greatly simplified.

As to the second source of trouble, namely, hæmorrhage after section—this almost always gives some trouble, and not infrequently a good deal. It is essential to complete the operation as rapidly as possible after dividing the nerve, in order to minimise the troublesome exophthalmos which occurs ; this complication is due to hæmorrhage behind the globe, and the eye may become so tense as to lead the surgeon to remove it, rather than to persist in returning it, and applying a bandage. Something can be done by inserting the closed blades of a pair of scissors, curved on the flat, and letting out the blood thereby. The tension is sometimes so great that it may be impossible to suture up the cut ends of the rectus muscle.

Even when the exophthalmos is extreme, the surgeon should make a strenuous effort to get the eye back into place, and to keep it there by firm bandage pressure. If he does so, he will very seldom have to fall back on enucleation, and will be surprised at the satisfactory appearance of the part when he dresses the wound on the third or fourth day. In his later cases the author used to inject adrenalin chloride solution deeply into the orbit before commencing the operation, and he found that this greatly controlled the tendency to troublesome hæmorrhage.

The shooting pain, due to the disease in the eyeball, ceases from the time of operation, and in its stead for one or two days is some amount of ache, which can be easily controlled by morphia if need be, and which is due to

the tension. This rapidly subsides, and the patient is soon left free of all pain, and greatly relieved by the operation.

Optico-ciliary neurectomy is not an operation one enters light-heartedly upon, but, on the other hand, in selected cases, it justifies its inception by the very satisfactory results it yields. The subsequent cosmetic results are excellent, especially if it is possible to suture up the cut ends of the rectus muscle ; but even where this cannot be done, the appearance is often much better than can be obtained with an artificial eye. One need not mention the saving of expense to the patient, which is a great consideration to a poor native.

It only remains to add that optico-ciliary neurotomy is a very much easier procedure than the neurectomy. It has been said to be less efficacious, but a comparative series of the two operations may possibly disprove this.

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CHAPTER III

NEW GROWTHS OF THE EYEBALL AND ITS ADNEXA

The various forms of new growth met with in the Tropics do not differ essentially from those with which Western experience has made us familiar ; but, as has already been pointed out, the habits and environment of the people often exert a strong influence on the conditions prevailing at the time that these neoplasms first come under observation, and on the probability of surgical advice being accepted. Malignant disease is usually seen at a much later date in the Tropics than in Europe, and the opportunity for undertaking surgical interference, with a good hope of saving life, has in most cases been let slip, before the patient first presents himself (Plate VI.). Only too often, marked cachexia has already set in ; and many of the tumours are very large ; frequently they are ulcerated, and the discharge from them is foul and offensive to a degree. From time to time the effects of myiasis are superadded, with results that can be easier imagined than described, but which once seen can never be forgotten.

When a case does present itself at an early stage, for example, an epithelioma of the limbus, or a glioma of the retina, the patient or his relatives will absolutely refuse to allow operative interference, and he will only return, when the most that the surgeon can do is to endeavour to render what remains of life less horrible, and less painful than it otherwise would be.

Nor is it only malignant growths that are seen in such late stages. The size that comparatively benign tumours may attain must be seen to be appreciated. An excellent

illustration of this point is furnished by Fig. 100, which shows a teratoma of the orbit that came under the author's care in Madras. It will be observed that, relatively to the child's head, the growth was simply enormous, and that the features of the face were twisted out of shape by the pressure of the tumour.

Whilst on this subject, the author would wish to record his impression that, in India at least, congenital growths and congenital malformations are encountered with un-

FIG. 100.—Teratoma of the Orbit, before and after operation.
(ex *The Ophthalmoscope*.)

usual frequency. He cannot support this position by definite statistics, but would recommend the subject to the attention of young workers, for he feels that a lifetime, spent in gathering data bearing on this topic, would be productive of most valuable and interesting results. He suggests that if the proposition proves to be well founded, the explanation of the frequency of these growths may lie in the extraordinary amount of in-breeding which prevails amongst certain communities in the East.

Another point of interest to which he would venture to invite attention is that of tumours of the lachrymal

PLATE VI.

Epithelioma of conjunctiva, as the case first presented itself.

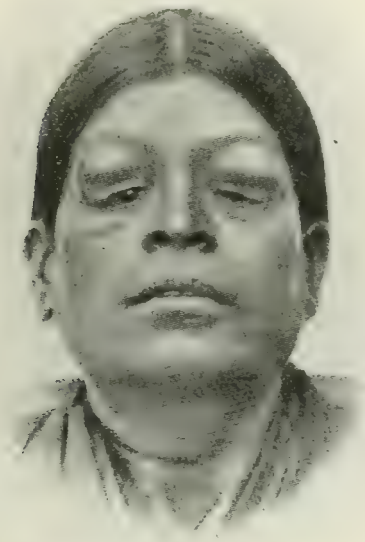

FIG. 101.—Mickulicz's Disease (front view). Note the fullness of the Parotid and submaxillary regions.

FIG. 102.—Mickulicz's Disease (side view).

FIG. 103.—Mickulicz's Disease, to show the larged accessory lobe of the lachrymal gla pushing the conjunctiva in front of it.

Note.—Figs. 101–105 are taken from *The Ophthalmoscope.*

gland, inclusive of Mickulicz's disease. Of the latter rare condition he saw at least two cases and knew of at least one other; he fears he may have overlooked some of the earlier ones. Those, who are interested in the subject, will find full details in the paper quoted in the reference. The illustrations show very clearly the appearance presented (Figs. 101 to 103). For the present, it will suffice to describe the condition as a chronic, symmetrical tumour formation of the lachrymal and of the various salivary glands. To revert for a moment to the other and usually more malignant lachrymal neoplasms, the author is impressed by the fact that at one time, in Madras, he saw 5 of these within a period of 11 months, though none had occurred in the previous 5 years, and on no subsequent occasion did he meet with such a rush of cases of the kind (Figs. 104 and 105). Once again he has no desire to strain the importance of these occurrences from the tropical point of view, but he feels that by making mention of these growths, he may do useful service in focussing the attention of others on the possibility of their occurrence.

Reference has from time to time been made to the need of operative interference in the late cases of exuberant new growth met with in the Tropics. The form that this interference should take is the complete exenteration of the orbit, a procedure which is as commonly called for in the East as it is rare in the West. It cannot be said that it is often successful in saving the life of the patient, but inasmuch as it removes a huge, fungating, foul, bleeding mass, it is a procedure of very great value. It has been urged against it, that the condition of the patient, and the likelihood of severe hæmorrhage, render it an operation of considerable danger to life, but this can hardly weigh much under the circumstances, especially if the pros and cons are clearly put beforehand to the patient or to his friends.

Exenteration of the Orbit.—Both canthi are divided; the lids are dissected free until the orbital margins are reached; with a periosteal rasparatory (Fig. 96) and a

PLATE VII.

Dermoid cyst of Limbus.

Fig. 104.—Malignant Tumour of the left Lachrymal Gland.

Fig. 105.—From the same case as Fig. 104, to show the involvement of the accessory portion of the gland.

pair of strong, blunt scissors curved on the flat, the whole contents of the orbit are removed right back to its apex. If severe hæmorrhage occurs, it may be stopped by the cautery, or by plugging, or by both. The author has never failed to arrest the bleeding, though he must own that in some cases it has been alarming in character; nor has he ever had a death attributable to this cause, or even to the operation itself. The lids are turned in to line the orbit, and the cavity is filled with antiseptic gauze, which is removed 24 hours later, and renewed daily. The use of an oily antiseptic preparation greatly lessens the pain of the dressings. The rapid improvement in the patient's general condition is usually a very striking and satisfactory feature.

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CHAPTER IV

THE CORRECTION OF ERRORS OF REFRACTION

It is commonly believed that savages and semi-civilised peoples possess an acuity of vision far superior to that enjoyed by the average European, but it is open to question whether such a view is well founded. To begin with, it must never be forgotten that a man sees not with his eyes but with his brain. The Red Indian on a prairie would pick out objects and would identify their nature with an accuracy that astonished the white man. Similarly, according to Rivers, the Australasian native excels all visitors to his island home in his power of seeing objects on land or sea, in his own surroundings. It is not, however, to be inferred that the acuity of vision among such peoples is greater than that found under conditions of civilisation. The explanation, as Rivers pointed out, is simply that the savage, dependent on his senses and wit for a livelihood and for protection from danger, develops to a maximum degree his power of interpreting the things which he sees. Just the same phenomenon is to be found amongst Europeans. The landsman gazes over a ship's rail at a cloud on the horizon and mistakes it for land; the sailor, with no better acuity of vision, or perhaps even with less, unhesitatingly and correctly decides on the nature of the object looked at. The engineer, looking down on a strange town, takes note of the evidence of motive power as manifested by signs which escape his lay brother. The ophthalmic surgeon recognises without difficulty the defects in the eyes of his fellow-travellers in the train or on the steamer, or of those whom he casually meets under any other circumstances. All this makes it

clear that sight consists largely in the psychical interpretation of the phenomena which are visualised, and enjoins caution in the acceptance of the view that those who live under primitive conditions have better sight than their civilised brethren. Roy, in a very interesting paper, has taken a different view of the subject, and from his examination of some 5000 negroes, belonging to 22 different African colonies, has come to the conclusion that normal vision in the Tropics should be regarded as $\frac{7}{5}$ rather than as $\frac{5}{5}$. The obvious comment on this is that the average British emmetrope has distinctly better vision than $\frac{6}{6}$; most of them will readily read $\frac{6}{5}$, and not a few $\frac{6}{4}$ or even better.

When full statistics are available, it will probably be found that the errors of refraction, with which we are familiar in Europe, are equally commonly met with in other parts of the world. It might be suggested that savage or semi-civilised peoples, who use their eyes comparatively little for prolonged near work, would probably show a smaller percentage of myopes than that which is met with in communities, the majority of whose members live by close use of their eyes. Such statistics, however, would have to be taken from the whole population, and not from the refraction records of an out-patient room. It will probably be found that, under the latter conditions, the ratio of the different errors of refraction to each other is much the same wherever the examination is made, provided that the subjects use their eyes to about the same extent for near work. If we take India, for example, the cases that come to us for glasses, are drawn almost entirely from the comparatively small communities which have adopted Western education. It is the clerks, the students, the Government officials, the lawyers, and so on, who want help for errors in refraction. The mass of the people are quite untouched by such needs. One consequence of this is that the demands made on the refractionist in an Indian hospital are comparatively light. The number of people who come for spectacles is small relatively to the mass of out-patients. The result is that ophthalmic work in the

East is much more interesting than it is in the West, and that the importance of the refraction department is dwarfed proportionately. It would therefore be a great mistake for the Head of an Eastern hospital, or for the majority of its officers, to devote a great deal of time to refraction work. This can quite well be left to one or more trained subordinates who will give the greater part of their time to it, and who will attain to a high degree of efficiency in this branch of work. As education progresses in any country, the importance and magnitude of the refraction department of a hospital will grow accordingly. The apparatus available in such a department should be of the best. Native assistants can be trained to use the astigmometer, the Wolff retinoscope, the refractometer and other similar pieces of apparatus with skill and accuracy. What is more, they will prove highly appreciative of the advantages of such aids to good work.

Not the least of the difficulties, which confront the tropical hospital, is the provision of spectacles, whether for ordinary errors of refraction or for aphakic eyes after cataract extraction. A large number of the people are utterly unable to pay for the necessary glasses, and it is for the Superintendent to use his ingenuity to obtain funds for the purpose either from the local Government or else from the charitably disposed.

Staphylococcus Infections. — In the hot weather in tropical countries, severe boils are very prevalent. These are due to staphylococcal infections. The natives believe that their onset is favoured by the consumption of acid fruits. The employment of staphylococcal vaccines (*S. aureus*) is of the greatest possible value. It is a point of interest, that those who are subject to this form of suppuration show a very low blood coagulability, and that, under the use of the vaccines, the time required for coagulation decreases very markedly. This would seem to support the popular prejudice against acid fruits, since the latter are known to diminish blood coagulability.

Those who suffer from errors of refraction and of muscle balance are, under the unfavourable circumstances

above outlined, very liable to develop numerous, large, painful styes. These, like other boils, yield readily to vaccine treatment. In the author's experience, calcium sulphide and the various other drugs, which have been recommended for the treatment of this form of suppuration, are absolutely valueless. On the other hand, the correction of the errors of refraction and muscle balance, and the use of vaccines speedily cure the condition.

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CHAPTER V

OPHTHALMOSCOPIC APPEARANCES IN THE TROPICS

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In considering the special ophthalmoscopic appearances found in the Tropics, it is, of course, necessary to bear in mind that we are dealing with dark-skinned races, in whose eyes there is naturally a great development of pigment; consequently the macula is a much more prominent feature in the fundus of the Indian than it is in that of fair-skinned races. This is so much so, that occasionally considerable experience is necessary to decide whether the development of pigment around the macula is pathological or physiological.

In the South of India, at any rate, the outstanding features in the ætiology of diseases of the retina, choroid, and optic nerve are—(1) The great extent to which the population is infected with venereal disease; (2) the great prevalence of septic conditions of the gums and intestinal tract; and (3) the extraordinary degree of in-breeding which exists.

1. Syphilis is very common amongst the general population, and well-informed observers have placed the rate of infection as high as 25 per cent. Careful notes on over 500 cases of fundus disease, taken at the Madras Ophthalmic Hospital, show a rate of over 60 per cent. of venereal disease, and in all probability the infection is even higher than this. It is a curious fact that, although syphilis is so common, the grosser manifestations, such as

palate perforation, septal perforation, laryngeal complications, etc., are comparatively rare. It is possible that a modified immunity may have been attained, and that the disease does not assume so severe a type as it does in less heavily infected communities. In considering this question, it should be borne in mind that the medical treatment of the disease is strictly limited, and although mercury is one of the stock remedies of the vaidyan, or native physician, yet the majority probably go without any treatment.

2. Oral sepsis, chiefly of the nature of pyorrhœa alveolaris, is also very frequent. It was found in over 47 per cent. of fundus disease cases at the Madras Hospital. The cause is probably, in part, the soft nature of the dietary which calls for a minimum amount of mastication. The disease is much more common amongst the well-to-do classes, and it is (or was until quite recently) the rule rather than the exception in persons of good status of over forty years of age. There can be little doubt that it has a large influence in the causation of the diabetes which is so common amongst this class. It is a common experience to find glycosuria disappear, when the diseased tooth sockets are drained by extraction of the teeth. Patients often give a history of previous glycosuria, but state that lately they have been free from the disease. When the mouths of such people are examined, it will usually be found that all the teeth have been lost, and that the pyorrhœa has undergone a natural cure in consequence.

Pyorrhœa, too, probably has an influence on the arteriosclerosis, which is so common, and thus it may be an indirect cause of many cases of retinitis.

The tropical flora and fauna of the intestine are numerous and varied, and it is no matter for surprise that intestinal infections are common. It is well known that a chill, such as would cause a bronchial catarrh in Europe, will give rise to an intestinal catarrh in the Tropics. East of Suez, the centre of gravity shifts from the thorax to the abdomen. In many parts of the Tropics, quite 70 per cent. of the population suffer from helminthiasis of some

form, and this must favour bacterial and protozoal infections of the intestines. An eosinophilia of over 10 per cent. was found in 40 per cent. of the fundus cases at the Madras Ophthalmic Hospital.

3. In-breeding is appallingly prevalent among Hindus in the South of India. The common custom is for a man to marry the daughter of his mother's brother, or, in some communities, his sister's daughter. It is an ordinary experience to meet persons who can trace their descent through at least six generations of such marriages. If people, who admit such practices to be the ordinary custom of their family, are included, there is a taint of consanguinity in about 60 per cent. of the general Indian population, whilst 71 per cent. of the fundus cases at the Madras Hospital showed such a taint.

An ophthalmic surgeon, on his first visit to the East, must be at once impressed by the amount of *optic atrophy* and *retinitis pigmentosa* which he sees there. Optic atrophy represents 32 per cent. of all fundus disease, and retinitis pigmentosa nearly 12 per cent.

Pure primary optic atrophy is not very common, and only accounts for 3 per cent. of the cases. **Pure secondary atrophy** is met with oftener, but the most common variety is one that is characterised by a deadly pale disc, which has clean edges perfectly free from organised exudation, but which shows a complete absence of cupping. Sometimes a slight thickening of the nasal branches of the retinal artery may be observed in the neighbourhood of the disc. The atrophy has apparently followed a very mild inflammation, or one which is situated behind the globe. Some months are generally taken for the disease to run its course, and, if untreated, it usually ends in complete blindness. The field of vision shows the contraction one would expect to meet with in cases of optic atrophy. The disease affects both eyes, but occasionally a typical primary atrophy may be present in one eye, and an atrophy of the type described in the other. Venereal disease was noted in 79 per cent. of such patients in the Madras Hospital. The disease represents 16 per

cent. of all fundus cases, and 38 per cent. of diseases of the optic nerve. If seen sufficiently early, there is a fair prospect of arresting its progress, and occasionally of effecting improvement by the active use of anti-syphilitic remedies.

Acute neuritis and **atrophy following neuritis** are fairly common in India. Many of the patients give a history of having suffered from headache and vomiting. Here again the commonest cause is probably syphilis, which has affected the meninges. At the same time, it must be admitted that it is rare to meet with gross changes in the brain membranes at post-mortems held in a general hospital. It is possible that, in some instances, dysentery may be a factor in the production of the optic neuritis. Thirteen per cent. of cases of acute neuritis had had an attack of dysentery within twelve months of the onset of their eye symptoms. It is well to bear this possibility in mind when treating cases of optic neuritis in the Tropics.

Retinitis pigmentosa is extraordinarily common in the East, and accounts for 21 per cent. of all diseases of the choroid and retina. A history of consanguinity can be obtained in 87 per cent. of the cases. The patients, who come for treatment, are generally between 30 and 40 years of age, but they are seen as young as 7 and as old as 70. The pigmentary and atrophic changes are probably more extreme than those met with in Europe, and the whole of the fundus is involved at a comparatively early date. Lenticular opacities form fairly early in the majority of the patients, but appear to be rather slow in progress. They are usually seen as a fine cobweb-like screen in the posterior layer of the lens cortex. A faint cloud of very fine vitreous opacities can always be made out, if a careful search is made for them. The reflex is greyer than that of a healthy fundus. The optic nerve has the dirty waxy appearance associated with retinal atrophy ; its colour is pinkish in the early stages, and yellow in the late. The retinal vessels are small, but do not show any signs of thickening as a rule. Bone-corpuscle-shaped pigment clusters are wrapped round the retinal

vessels, and scattered over the field in the diseased area, the ground of which looks as if powdered with a yellow-grey dust. The disease attacks the middle zone of the retina and choroid in the early stage, but later involves the whole fundus. Retinitis pigmentosa may often be suspected on seeing the patient enter the out-patient room, owing to the manner in which he peers around, and moves his head in the attempt to bring his contracted field to bear on the surrounding objects.

It is a curious fact that patients with retinitis pigmentosa show a higher rate of eosinophilia than those with other diseases of the retina and choroid (50 per cent. against 32 per cent.) ; a probable explanation is that long-continued imperfect vision, in the dim light of the early morning, has rendered them specially liable to the attacks of intestinal parasites, owing to their difficulty in preserving cleanliness.[1]

A General Atrophy of the Retina and of the Inner Layers of the Choroid, with pigmentation of the inner layers of the retina, is exceedingly common. This condition is, in many instances, quite indistinguishable from the later stages of retinitis pigmentosa, and one has to rely to a great extent on the history of the case in forming a diagnosis ; for an intelligent patient, suffering from retinitis pigmentosa, will always tell of a long period of night-blindness before his day-sight failed badly. Other points in the diagnosis are—(1) that actual scarring, through which the white sclera is seen, may be present ; and (2) that the retinal vessels show greater changes in this disease than in retinitis pigmentosa. The condition is nearly always caused by syphilis, and follows an acute specific retino-choroiditis. These patients sometimes show an improvement under active anti-syphilitic treatment, combined with subconjunctival injections, always provided that there is some functioning retina left.

Acute General Syphilitic Retino-Choroiditis accounts for 10 per cent. of diseases of the choroid and retina. In this condition the fundus can only be dimly seen through a fog of very fine vitreous opacities. The optic nerve

[1] The natives habitually defecate in the early morning.

appears to be flushed and slightly swollen, and fine streaks may be observed along the course of the retinal arteries. Occasionally, a small arterial twig may be seen to be obstructed, and to have a flame-shaped hæmorrhage in its vicinity, but it is rare to see actual exudations. In some cases the anterior part of the uvea shares in the inflammation, and a quiet iritis may be found.

Pyorrhœa is very common in these patients, and it is possible that it may have some influence on the causation of the disease. In any case, there can be no doubt that, if it is present, attention should be paid to its treatment. Very active anti-syphilitic measures should be carried out; 606, or a similar remedy, should be administered intravenously, and a mixture of mercury and iodide of potash given internally. Subconjunctival injections of cyanide of mercury should be given and repeated when possible, whilst inunctions of mercury ointment, or of oleate of mercury, should be made into the eyebrow.

Central Forms of Retino-Choroiditis, including the senile manifestations, represent about 20 per cent. of all diseases of the choroid and retina. A common variety is that which is observed in connection with branches of the macular arteries; lying under the finer twigs of these, are seen yellowish rounded spots having a soft, faintly pigmented border. These are often arranged in clusters like a bunch of grapes. The spots vary in size from a mere speck to about $\frac{1}{8}$ disc diameter across. Sometimes they may be observed to be very slightly swollen, but more commonly no swelling can be detected. Pyorrhœa, venereal disease, dysentery, and malaria are often present in such patients: but, as a rule, it is impossible to assign any particular cause for the condition in individual cases.

Disseminated Choroiditis is distinctly rare, and such forms of exudative choroiditis as have been seen do not appear to be associated with an unduly high rate of venereal disease.

Exudative and Hæmorrhagic Forms of Retinitis are not uncommon, but are relatively more frequent in Europeans and Eurasians than in Indians. The causes are the usual

ones, namely, albuminuria, arterio-sclerosis, diabetes, and occasionally syphilis.

Sun-blindness, with macular degeneration, is not uncommonly met with, and the ophthalmoscopic picture is quite characteristic. The macula forms a crater of deep crimson colour, $\frac{1}{8}$ disc diameter in width, the edges of which are sharply cut and irregular in shape ; it is surrounded by a soft cloud of pigment. The extent to which vision is interfered with varies considerably ; a patient is sometimes able to see as much as $\frac{6}{12}$, but more often the sight is nearly completely lost, and he is only able to move about with some difficulty.

In this connection, it is interesting to note that it is part of the Brahmin ritual to look at the sun whilst reciting a particular "mantram" during the midday prayer (*vide*, p. 63). The practice is to fold the fingers in a peculiar manner, and look at the sun through the interspaces. The orthodox fashion of folding the fingers leaves an aperture of about an inch square, but it seems that all Brahmins are not equally particular as to the manner of folding the hands ; indeed, some of them do not even go outside the house to perform the rite, but are content to take the presence of the sun for granted, and merely to address the light. The mantram itself only takes three or four seconds to recite, but one may imagine that the tropical sun, if looked at directly, is capable of doing damage, even in this short space of time. In some places, it appears to be the custom to look at the rising sun directly, without the intervention of the fingers, and in such a case the time may be extended to four or five minutes. It is remarkable that this disease is by no means confined to Brahmins ; indeed, those who are not Brahmins have furnished the majority of the patients. The probable explanation is, that this practice, having a religious sanction, is followed by men of other castes, and that these imitators are inclined to carry it to excess ; it is sometimes considered to be "lucky," and to confer supernatural powers. This idea most likely originates in the extensive use of self-hypnotism by "yogis," who, for this purpose, are in the habit of fixing a sustained gaze on some

bright object, or of using their eyes in some manner which entails a fatigue of the ocular muscles. Thus a common yogi habit is to gaze at the tip of the nose, or at the eyebrows; the power of sustained over-convergence, which they thus acquire, is, in some cases, astonishing. Sun-gazing in the morning and evening appears to be one of the methods of self-hypnotism. Amongst the less zealous worshippers the disease is often monocular, as some, at least, of them appear to have a doubt as to the wisdom of tampering with such things and, tempering their zeal with discretion, risk the sight of one eye only. On the whole it is extraordinary that sun-blindness is not more common than it is.

Errors of Refraction are very common amongst the student and clerk classes, and the slighter errors often appear to be unduly felt. The desire to form a large retinal image causes the majority of students, suffering from hypermetropia or astigmatism, to shorten their working distance, and starts them on the vicious circle that leads to asthenopia. In dealing with such cases, it is of just as much importance to induce the patients to lengthen their working distance as to correct their refraction error.

High myopia is, if anything, less common than in European countries; it is not confined to those who use their eyes excessively for close work, but is comparatively often seen in the illiterate agricultural labourer.

Accommodative power fails at an earlier age in Indians than in Europeans, and, at the same age, it will be found necessary to prescribe correspondingly higher powered lenses for presbyopia.

The European resident in the Tropics is seldom at more than 90 per cent. of health efficiency, and he therefore experiences ciliary strain more readily than does his brother at Home; it is advisable to take this fact into consideration when prescribing glasses for him. Refractive errors are generally felt most acutely at the end of the first month of the hot weather. Eye strain, in those who have a predisposition to it, is one of the penalties that the European has to pay for residence in the Tropics.

CHAPTER VI

HOSPITAL MANAGEMENT

The Western surgeon walks into his hospital, at his visiting hours, to find everything prepared for him; he does his professional work, and leaves with the happy confidence that then and there his responsibilities end. It is very different in the case of his colleague in the East, who is not merely in medical charge of the sick, but who in addition is responsible for every detail of the organisation of the institution. The staff, from his most senior medical officer down to the lowest sweeper, look to him as their Chief. As for the patients, it is his care that ensures, that they are comfortable, that they are properly fed, and that no advantage is taken of their ignorance and helplessness. On his shoulders rests the responsibility of seeing not merely to the cleanliness of the wards and of the precincts of the hospital, but also to their hygiene and to their freedom from animal and other pests. We shall take these different matters in turn, premising all that follows with one piece of advice, which has already been given in the first chapter of this book, but which nevertheless demands repetition, since it is of paramount importance to every administrator in the East, no matter what branch he belongs to, namely, *learn the language* of the people amongst whom you work. Your staff will never respect you, nor will they have the wholesome fear of you, which they should have, if everything that comes to you from the native population has to do so through the medium, only too often tainted, of a translator. Nor will your patients have that confidence in you with which you desire to inspire them, and which alone leads to the attainment

of the best professional results, unless their wishes, their fears, their troubles, and their symptoms can be made known to you at first hand.

The Staff

The work of a hospital in a tropical country must be carried on with the aid of a far less highly trained staff than that which would be considered necessary for an institution of the same kind in Europe. Thanks to the labours of those who have gone before, locally qualified medical men can be obtained in most parts of our Eastern and colonial possessions. Again, the place of the nurse, as we know her in the West, must be taken by a native substitute. In the male wards we employ ward-boys; in the female wards, ayahs. These are the terms used in the East. In all essential characteristics the attendants differ comparatively little anywhere in the Tropics, though the names applied to them naturally vary widely. It might be thought that with such a staff as we have described, good work would be impossible, and indeed surgeons have not been wanting, who have advocated the adoption of a lower standard in the East than that which is accepted in the West. Against such a heresy the author strongly contended during the many years of his work in India. If the Head of a hospital will learn the language of the people, will closely study their customs, will make himself *au fait* with the duties of every man under him, from the lowest to the highest, will assign to each man his work, and will, if necessary, teach him how to do it, he will bring the institution under his charge to a very high state of efficiency. The author, of course, speaks for the East, but what he says of it applies, he is confident, to any other tropical country. The conscientious Superintendent is almost worshipped by his staff, and it is their pride to work under him. The high grade of efficiency that uneducated men will attain to, if properly taught and encouraged, is one of the wonders of tropical work. Should any one desire to learn this lesson practically, let him study some of the Indian hospitals

on the spot for a few weeks. Visitors are always warmly welcomed by those who are in charge of these institutions.

However large the staff, the Superintendent should know every member, down to the most menial servant, both by face and by name. He should be accessible at suitable times to any one and every one, who has a grievance he can remedy, or a trouble he can share. He should make them feel that they are what they term themselves in approaching him, "his children," and that, to use their own expression, he is "their Father and their Mother." At the same time, he must keep a proper reserve, and must learn just that blend of interest and aloofness, which has made the Briton the foremost colonist of the world. Intimacy with native peoples, if divorced from a suitable reserve, is fatal to influence or to prestige. An overbearing and insolent manner is equally prejudicial to good success, apart from the fact that it stands self-condemned on other and far wider grounds.

The Superintendent of a large hospital should not be content with visiting it at stated times, and forgetting it for the rest of the 24 hours. He should drop in when he is least expected either by day or night, in order to make sure that the duty-members of the staff are present, and that the patients are being properly cared for. He should specially make a point of paying surprise visits at meal-times, and, unpleasant though it may be, he should, from time to time, taste the food supply, and satisfy himself that it is well cooked and palatable. In this latter detail he must learn to appreciate the tastes of his patients so that his judgment may be a correct one. In the course of such visits he should find time for short chats with some of the patients. The man with human sympathy, who can talk to them in their own language, not only about their present anxieties, but about their children, their crops and the thousand other little things which interest them, will greatly enlarge the value and efficacy of his work thereby. He will learn, too, of practices, which it is both his interest and his wish to suppress. In the East blackmail is rampant. The patients are told

by the attendants that this, that, and the other concession can only be granted if paid for. Too often the unfortunate patient is given to understand that some, at least, of the money thus extorted from them is paid to the officers of the institution, and even to the Superintendent himself. Nothing that the latter can do, will go farther to dispel such ridiculous falsehoods, than his giving the people an opportunity to know him as a man, and not merely as an official. It may seem to some that such a disquisition is outside the scope of a book on Tropical Ophthalmology, but it certainly is not. The patients in an eye hospital are mostly in good general health, and of active mind. They therefore feel all the more intensely the helplessness of blindness. The man who is a surgeon alone, and who fails to realise the psychologic position of these unfortunate people, is a bird with clipped wings; he will never soar to the heights of success that are possible to him.

A great danger in an Oriental eye hospital lies in the ambitions of some of the menial staff. Such men, with a meagre smattering of ophthalmic knowledge, with an ignorance which blinds them to the consequences of their acts, and with a greed that overpowers all conscience, will set up an *imperium in imperio*, and, under the shelter of the authority of the hospital, will practise a debased mixture of Oriental and Western surgery, even going so far as to persuade patients to leave the hospital in order to submit themselves to couching by their hands. The best antidote for all this is the establishment of the patient's confidence in the Head of the institution. Few things are more astonishing in the East, than the ignorance of each other's point of view, in the minds of the European and the native. It is possible for a man to live amongst an Oriental people, to give his life to their service, and yet to be conscious throughout that he knows little or nothing of their mental view-point, and that they are in the same position with regard to him. The knowledge that the Superintendent is, even in some small measure, in human touch with his patients, will make those who

work under him, more careful how they misrepresent him, and less prone to take advantage of the patients. What is more, from time to time, information will leak out, often fragmentary and involuntary, which will give an indication, possibly only a faint one, of what is going on. No man can contend successfully with the underground forces of the Orient, but even a little knowledge will prove a valuable thing, provided always that it is recognised that it is at the best very little and very partial.

Once again, the critic may cavil at the repetition of advice which has already been given earlier in this book; but, such repetition has been deliberate and intentional, for the matters dealt with are of such cardinal importance that if they are forgotten or ignored, the reputation and the success attained by the practitioner in the Tropics will be very greatly lessened.

Administration

The Superintendent of an Eastern hospital is often called on to feed and clothe his patients, as well as to watch over their welfare generally. This adds greatly to the interest of his task, especially if he takes these duties seriously. We shall consider a few of the leading points in turn.

The Purchase and Storage of Food.—It is usually a great economy to purchase food-stuffs in the mass, and this is best done through the agency of native contractors, who compete with each other in the matter of price. It therefore becomes part of the surgeon's duty to know the various food-stuffs of the country he lives in, and to be able to discriminate between different samples in order to get the best value possible for his hospital. Once he begins to study the subject, he will be surprised to learn its magnitude. Take rice, for example—different castes in India eat different kinds of rice; what is suitable for one is unsuitable for another. Again, if the Superintendent buys too new a rice, it will dry up, losing weight thereby, with the result that his supply will not last the

calculated time; on the other hand, if he buys it too old it will be eaten by weevils, with even more loss than in the case of the new. The purchase of curry stuffs, such as cardamon seeds, ginger, turmeric, and tamarind fruit, calls for experience and judgment. The supplies of meat and fish require a very watchful eye, or "second-sort" will be substituted for the best; and so on through a very long list.

Then there is **the clothing** to consider. Many of the patients come in such a filthy condition, that it is advisable to supply one and all with hospital clothing during the whole time of their residence. Their own possessions must be sterilised and stored, their valuables sealed up and put away, and suitable changes of apparel served out to them. The cloth, etc., must be bought in the cheapest market with due regard to the quality of the material. The making up of the garments must be farmed out at rates advantageous to the institution. The sewing, the buttonholing, the finishing and so on, must be inspected before the articles are accepted. The condemnation of worn-out clothing must lie in the hands of the Head of the hospital, though he may depute much of this work, under proper supervision.

Again the question may be asked—What has all this to do with ophthalmic work in the Tropics? The answer is "everything." If your patients are not properly clothed and properly fed, you will not get the best results with them. There is an Eastern proverb which should never be forgotten, "The eye of the master maketh the ox fat."

At least once a week, the Superintendent should make a **formal inspection of every part of the institution** under his care. This may take a lot of time, and involve a long walk in a hot climate before he is through with it, but the duty should not be shirked. The storehouses for foods, the kitchens, the lavatories, the latrines, and every other part of the institution should be inspected, with an eye not only for accumulations of dirt, but also for the ravages of white ants and of other insect pests, and for the effects of climate. The last-named constitute no negligible factor in tropical

lands, where deep rifts open in the ground in the dry weather, and close with the advent of rain ; a crack may be found extending across a ward from side to side, up its walls and athwart its roof, constituting a menace to the blind people sheltered within the building.

A word must be said on the **care of poisons.** These should always be kept very carefully under lock and key, and their expenditure should be closely watched ; otherwise they will be stolen and sold in the bazaar. This especially applies to cocaine, which fetches a comparatively high price in the East, and which is much abused by many of the natives.

The Indian crow.—No one, who has not watched these birds, can form a just idea of the pest they constitute in a hospital, where many of the patients are blind. Even in other institutions, they have a very evil reputation as shameless and persistent thieves ; but their knowledge of the limitations of the blind seems almost satanic. The author has, on not a few occasions, watched two of these birds perch on opposite sides of an old woman's bed, just after she had been served with her morning breakfast of "hopper" (a kind of pancake) and coffee. One bird would caw defiantly ; if the patient proved unwise enough to strike out blindly in its direction, the other from the opposite side would dive in and seize her food. So great an evil was this that, in Madras, it was thought necessary to have all the new blocks enclosed on the outside of the verandahs with coarse wire netting to make them crow-proof. Only certain doors were left for entrance, these too being crow-proof.

The care of waiting Patients.—Many of the patients who come to an Eastern hospital, require treatment for some little time before admission, and not a few of them are so limited in means that they cannot wait for the purpose. Special arrangements should be made for these people, either through the agency of Government, or through the medium of private charity. Many of their wealthier neighbours will subscribe funds for the purpose, if approached in the right way. It is for the Superintendent

to find out what that way is. Notoriety, especially when it attracts the attention of Government, will prove a bait to some; the acquisition of merit will attract many of the orthodox; whilst pure human sympathy will be a lever in the case of many others.

In conclusion, a few rules may be formulated, which the author believes will prove of great value to those who follow them:

1. **Respect caste** punctiliously, but exercise a careful and tactful supervision over every detail of hospital management. The native of tropical countries is no fool: he may have little education, but he is a shrewd observer, and it will not take him long to realise when a man is honestly working for his good; he will then make allowances for him accordingly.

2. **Learn** all you can of **native customs,** of **lucky and unlucky days and hours,** and of **good and bad omens,** and as far as possible respect the prejudices founded upon such beliefs. Such a course of action will gain you the confidence and support of the people for whom you are working.

3. **Know the work of every man, who is employed under you,** from the highest to the lowest, so that you can teach him how to do it aright. You will not then be nonplussed when a subordinate tells you that a certain thing "cannot be done": take the task from him and do it, and that argument will not be repeated a second time.

4. **Do nothing yourself which you can get equally well done for you by someone else.** Your task is very great; and your strength is too small to be frittered away in doing needless work. Be the brains of the institution you control, and see that everyone under you carries out his or her work efficiently!

5. Lastly, and once again, **learn the language** thoroughly, and study through it the habits and customs of the people for whom you work.

SECTION X

GENERAL DISEASES

CHAPTER I. BERIBERI.
Epidemic Dropsy.

„ II. CHOLERA.

„ III. DYSENTERY.

„ IV. LEPROSY.

„ V. MALARIA.
Introductory.
The ocular signs and symptoms of malaria.

„ VI. QUININE POISONING.

„ VII. PELLAGRA.

„ VIII. PLAGUE.

„ IX. SMALLPOX.

„ X. TRYPANSOMIASIS.

„ XI. TYPHUS.

„ XII. YAWS.

„ XIII. VARIOUS GENERAL DISEASES.
Black-water fever.
Dengue.
Diabetes.
Enteric fever.
Heat-stroke.
Sand-fly fever.
The tropical relapsing fevers.
Undulant fever.
Yellow fever.

CHAPTER I

BERIBERI (KAKKE, BARBIERS)

(Written in Collaboration with Prof. S. Miyashita, of Osaka, Japan.)

According to Manson, "Beriberi is a form of multiple, peripheral neuritis, occurring endemically, or as an epidemic, in most tropical and subtropical climates, and also, under certain conditions, in more temperate latitudes. The mortality is considerable, death usually depending on heart pareses."

Distribution.—This disease is so widely distributed over the Tropics, that it would be almost easier to say where it does not occur than where it does. It has, however, been most closely studied in Japan, India, Brazil, and the Federated Malay States. This is probably merely due to the accident of the presence of enthusiastic observers in those countries. The question has been raised as to whether the kakke of Japan is identical with the beriberi of India and other neighbouring countries. There is a school of thought in Japan, which leans to a doubt on this question, and Miyashita is inclined to lay some emphasis on this point. This is the more important, since the eye symptoms have been mainly studied by Japanese observers. It must, however, be owned that the two conditions have much in common, and indeed the majority of writers would still appear to think them identical. It is manifestly impossible to discuss this question at length here, and in the present state of our knowledge, the simplest course is to assume that beriberi and kakke are one.

Ætiology.—Beriberi attacks both sexes equally. It

may be transmitted by nursing mothers to their children. It is a disease of young adult life, those affected lying between 16 and 30 years of age. It is said by Manson to be fostered by damp and by high temperatures, and to be reputed to attack those who sleep on or near the ground. Miyashita states that in Japan it is most frequent in the summer season, that is in July, August, and September. He adds that although the ophthalmic symptoms may be met with at a very early stage of the disease, they do not, as a rule, occur until after an interval of 1 to 3 months from the commencement of the trouble. Hence in Japan they are most frequently seen in November, December, and January. He makes another point of great interest, namely, that, whilst they are more common in males than in females, a marked exception is found in the latter during pregnancy, and after the lying-in period ; at such times the liability of women to exhibit the ocular symptoms of beriberi is greatly increased. These observations are in general accord with the experience of other writers (Aoki, Yamamoto, Ichihara).

Some idea of the frequency of the eye symptoms of beriberi in Japan can be gathered from the statistics compiled by Ichihara, who found that in 6000 out-patients there were 32 cases of amblyopia (0·53 per cent.), and that of these 32, no less than 6 were due to beriberi (18·75 per cent.).

The Causa causans of Beriberi.—Many observers have pinned their faith to the view that the disease is caused by a germ, or by some allied organism. Others have contended that it is a deficiency disease, in which the body is deprived of something essential for its healthy nutrition. Manson goes a step further, and considers it possible that the condition, brought about by such deficiency, merely predisposes to, or facilitates the operation of something else, perhaps an unknown germ, which, but for this deficiency, would remain inoperative, even if introduced. In any case, it is widely accepted that beriberi is apt to break out amongst people, who subsist on rice from which the pericarp is removed, and that some

substance in this pericarp is at once a preventive of the disease and an agent in its cure.

We shall not linger over the general symptoms of the two main forms of this affection, namely the paraplegic and the dropsical (Figs 106 and 107), but shall at once proceed to discuss the eye symptoms.

The Eye Symptoms of Beriberi.—These fall under three heads : (1) Retrobulbar neuritis, (2) paralyses of the muscles of the eye, and (3) decreased sensibility of the cornea and conjunctiva.

1. **Retrobulbar neuritis.**—In 1895, Kono published 6 cases of beriberi, associated with *amblyopia, central scotoma*, and *contraction of the visual field*, but presenting no fundus changes. Three years later, Komoto discovered that the cause of the amblyopia and of the central scotoma was to be sought in a retrobulbar neuritis, and added that the scotoma began centrally and spread centrifugally. In 1899, Tsurumaru published 10 cases of central scotoma, associated with yellow vision, amblyopia and xerosis of the conjunctiva. Komoto and Aoki added a case of 18 years' duration, in which the amblyopic patient was able to see better in a subdued light, and was therefore at his best at dawn or in the twilight. Yamamoto seems to have been the first (1903) to draw attention to an atrophic condition of the temporal side of the disc in these cases. A number of other Japanese surgeons have added to our knowledge on the subject, but we may for the moment pass by their work and come down to Kagoshima, who has recently (1918) made an anatomical examination of 5 cases in which kakke-scotoma was present, and has found in all of them a distinct and limited atrophy of the fibres in the outer section of the optic nerve ; he has thus set a crown on the previous work on the subject.

The signs of retrobulbar neuritis fall under three headings—(i.) *Central scotoma*, (ii.) *diminution of the central visual acuity*, and (iii.) *changes in the visual field*. The above order is deliberate and represents their relative importance from the point of view of diagnosis.

(i.) *Central scotoma.*—We have already traced the

FIG. 106.—Paraplegic Beriberi. (Bentley.) (*ex* Manson's *Tropical Diseases.*)

FIG. 107.—Dropsical Beriberi. (Bentley.) (*ex* Manson's *Tropical Diseases.*)

history of the discovery of this sign. In the earlier stages, the scotoma is of small size, and according to Miyashita it is connected with the blind spot by a narrow bridge (Fig. 108), thus giving it what he speaks of as "its most characteristic pestle-shaped form." He attributes this observation to Tshizu (1917) and Fugita (1918). The earlier writers do not appear to have noticed this peculiarity. Ichihara described the defect as having an irregular, elongated, oval form in one case, and as being half moon-shaped in another; the latter was of 20 years' standing. Yamaguchi. in the paper from which Ichihara's

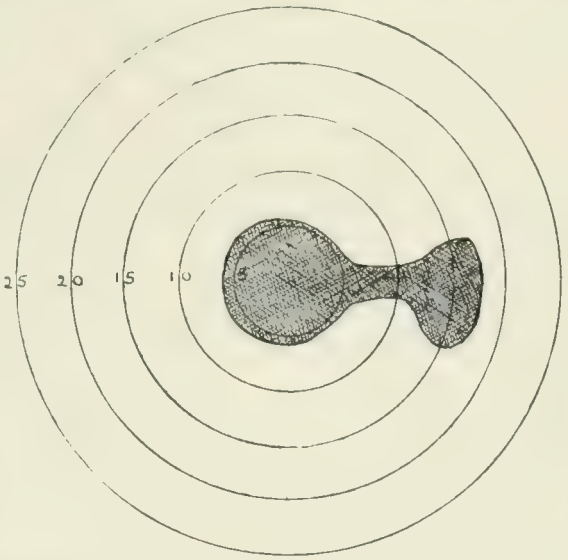

FIG. 108.—The Pestle-shaped Scotoma of Beriberi (according to Professor Miyashita).

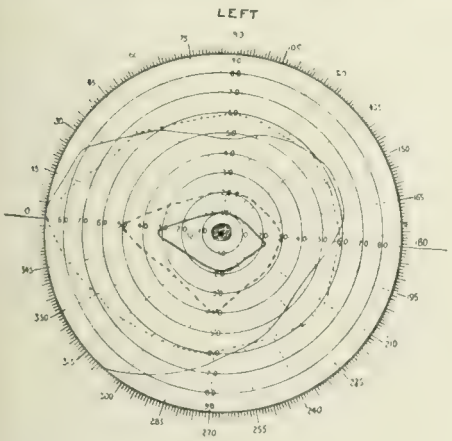

FIG. 109.—L. E.

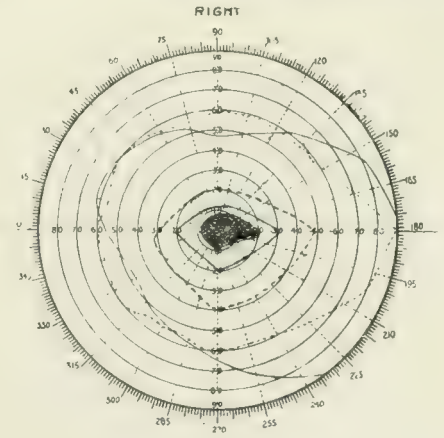

FIG. 110.—R. E.

Fields of Vision in Beriberi after Yamaguchi.

Green———— Red---------- White.....

Note the central scotoma in each eye.

description is extracted, delineates the scotomata as shown in Figs. 109 and 110. Aoki described the white and colour scotomata as nearly always obliquely oval, and added

that the size of the latter diminished in the following order, green, red, and blue. This last observation has been confirmed by the independent testimony of Yamamoto. Coppez, in one case home from the Congo, found an absolute central scotoma for red and green, and a relative one, covering 8 degrees of the field, for yellow and blue. He records the interesting fact that the patient was able readily to pass the test with coloured wools. Miyashita, on the other hand, speaking from a much larger experience, states that the colour sense is disturbed in many of the cases, especially for green.

(ii.) *Diminution of the central visual acuity.*—Miyashita states that "whilst the scotoma enlarges, the central vision gradually falls till it reaches the low limit of $\frac{6}{60}$; he adds that it seldom goes lower than this. It is this interference with vision which drives the patients to seek medical relief, and thus leads to the recognition of the diagnostic symptom of central scotoma. It has already been mentioned that one observer noted yellow vision in connection with beriberi (Tsurumaru). The author ventures the suggestion that this may have been a mild degree of erythropsia, especially as it was associated with xerosis; Oriental patients, in his experience, are apt to confuse yellow and red. Miyashita states that a certain degree of photophobia is observed in these patients, and that some of them find that they can see better in the house than they can out of doors. This is a confirmation of a similar observation by Komoto and Aoki, which has already been quoted. He adds that there is also some interference with dark adaptation, and attributes the observation to Nakamura (1919). The remark again recalls Tsurumaru's observation, alluded to just above, of xerosis in one of his patients, for as we have already seen (Section II. Chapter VI.), night-blindness is closely associated with xerosis.

(iii.) *Changes in the visual field.*—These would appear to vary very greatly in different cases. Many of the writers make no reference to any constriction of the limits of the fields either for white or for colours. Coppez went

out of his way to record that peripheral vision was undamaged in his case. Ichihara states that contractions of the visual field occur, but are transitory in nature. Yamaguchi found no marked contraction of the white field, but those for red and green were shrunken (Figs. 109 and 110). It is of interest, in this connection, to remember that, though atrophy of the papillo-macular bundle is of not infrequent occurrence, general optic atrophy has apparently been but rarely observed.

2. **Paralyses of the Muscles of the Eye.**—A study of the records would suggest that, at the earlier stages of the investigation of beriberi, comparative little stress was laid on paralyses of the eye muscles as a sign of this disease, although, from the first, it was recognised that these might occur. Manson says, "Very rarely is there any paresis of the ocular muscles." Yamaguchi speaks of the occurrence of paralyses of the muscles of the eye and especially of the accommodator muscle. Da Silva Lama makes a reference to diplopia and convergent strabismus (? abducens paralysis) in his cases in Brazil. Wright remarks that the internal ocular muscles may not escape in the more severe cases of this affection. All that Stitt has to say on the subject (1917) is that "the Argyll-Robertson pupil is absent." The remaining writers, so far as the author has been able to ascertain,[1] are silent on the topic of these paralyses. Miyashita's evidence is therefore of all the more value: "Captain Ishizu, who examined several hundred cases of kakke, reported in 1918 that he had discovered a large frequency of instances of insufficiency of the external rectus muscle (which he thought might be caused by paresis of the nervous abducens), and that he had also seen a few cases of paresis of the internal rectus muscle. The prognosis is always good. B. Nakamura and I saw in 1918 an adult with paresis of the lid elevator. The picture presented suggested for a time the possibility of myasthenic ptosis."

[1] The author has been unable to gain access to Marubi's paper on "Paralysis of the Eye Muscles in Beriberi." It is, however, included in the references at the end of the chapter.

"Then a few words on the kakke of newborn children, which is transmitted to them by their mothers' milk. In these little patients, the most outstanding symptom is ptosis; very few cases of optic neuritis have been reported among them. Stoppage of the infected milk cures the eye symptoms."

3. **Decreased Sensibility of the Cornea and Conjunctiva**.—The only information that the author has been able to obtain on this subject has again come from Miyashita: "Captain Ishizu found (1918) in the earlier stages of kakke that there was a distinct decrease of sensibility of the cornea and conjunctiva in more than half of all the cases he examined. This defect disappears completely on the recovery of the patient from the general signs of the disease."

Ophthalmoscopic Appearances.—Yamamoto states that the visual symptoms of beriberi may be found in association with three distinct conditions, as seen by the ophthalmoscope—(1) There may be absolutely no evidence of any fundus lesion; (2) there may be partial atrophy of the papilla, limited to its temporal quadrant; or (3) the whole of the optic disc may be involved in the atrophy. Ichihara is among those who lay stress on the atrophy of the papillo-macular bundle in this disease.

Prognosis.—Attention has already been called to the fact that the eye symptoms of beriberi may anticipate the general signs of the disease in the earliness of their advent, but that as a rule they do not put in an appearance until the latter have been recognised for several months. In a number of the cases, great improvement has been found to attend the treatment of the complaint by means of a change in diet. In Japan it is the custom to suspend the use of rice and to substitute a bean known as "azuki" (*Phaseolus radiatus*). Under this régime the scotomata rapidly diminish, but show a tendency to return if a rice diet is resumed (Aoki). Yamamoto adopted a similar practice, and with like results, but combined barley with the bean. Still other substitutes have been employed by various surgeons. Yamaguchi saw a complete recovery

from all eye symptoms result after a month of diet, etc. If this rational line of treatment is not adopted, the prognosis is a bad one, and especially so in ill-nourished people, who are said to be the most prone to develop eye symptoms; but, as has already been stated on the authority of Miyashita, the central vision, even in the worst cases, seldom falls below $\frac{6}{60}$. That writer further observes that, though a cure can in some cases be obtained, the degree of recovery differs in different instances; apparently it cannot be predicted beforehand; all that can be said absolutely is that complete blindness need never be anticipated.

Pathology.—We have already dealt with the evidence in favour of the papillo-macular bundle being selected for invasion and atrophy in beriberi. Naturally this has led observers to compare this disease with tobacco and alcohol amblyopia, with lead poisoning, and with other forms of intoxication.

With regard to the muscular paralyses, Wright has recorded "a mild chromatolysis in the trophic cells of all the affected nerve fibres, when examined by Nissl's method." He states that the muscles whose nerves are degenerated show all the signs of a simple chronic atrophy, whilst "the affected nerves show a chronic degeneration, Wallerian in appearance." He compares beriberi to diphtheria in the matter of the residual paralyses observed in both conditions.

Treatment.—The lines on which this should be conducted have already been indicated, the main feature being the substitution of some other food for the dangerous forms of polished rice. Whatever is given should contain a sufficiency of nitrogenous and fatty elements, and should not be too bulky. Removal to a more favourable climate is indicated, and this advice, in the case of Europeans, should be translated to mean "leave home." The patient should sleep well off the ground, in an upstair room if possible, and his quarters should be well ventilated and sunny. Purgation by magnesium sulphate is recommended, as also are injections of pilocarpin and strychnine,

as well as the use of various other drugs. Breast-fed children should be weaned.

EPIDEMIC DROPSY

It is no part of our present task to discuss the relationship of this disease with beriberi, but only to record the fact that Maynard in Calcutta saw over 20 cases of glaucoma associated with a wave of an epidemic to which the above title was given. The main interest of this observation to the ophthalmologist lies in the suggestion, that we have here to do with a rise in tension, consequent on a pathological hypersecretion from the ciliary body; whereas, in the vast majority of cases of glaucoma the trouble lies in an obstacle to excretion. The use of a meiotic is indicated. If operation proves necessary, a sclerotomy will probably suffice. As a last resource an operation for the production of a filtering cicatrix may become necessary. If so, the author would recommend sclero-corneal trephining.

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As a large part of the literature has been published in Japan, it has been very difficult to refer to originals.

CHAPTER II

CHOLERA

A VERY early sign of cholera is a **blue discoloration** of the skin **of the eyelids** (cyanosis). Another feature which soon attracts attention, is that the **eyes are kept half open,** owing to a difficulty the patient has in closing them. This is due not merely to weakness of the orbicularis, but also to the fact that the shrinkage of the cellular tissues of the orbit causes a retraction of the globe, and thus, it is presumed, deprives the muscle of its normal area of support. The patient *can* close the eyes when told to do so, but after a little time they open again from very weariness (Santos-Fernandez). The **lachrymal secretion**, like all the fluids of the body, **is dried up**; the consequence is that the surface of the eye is deprived of the natural protection, usually afforded to it by the flow of tears; this is undoubtedly an important element in the onset of the conjunctival and corneal troubles to be presently described, for the irritation caused by exposure, dust, and the assaults of insects fails to stimulate the lachrymal gland to perform its normal functions of moistening and cleansing the surface of the globe. Whilst the patient lies unconscious or semi-conscious with the eyeballs rolled upward, the **lower parts of the cornea and conjunctiva remain exposed** in the palpebral aperture of the half-opened lids. This exposure, taken together with the absence of tears, and the depressed condition of the patient's health, is fully sufficient to explain the conjunctivitis, the ulceration of the cornea, the kerato-malacia, and even the massive sloughing both of the cornea and sclera, which is sometimes seen in this disease, and which can be prevented in most cases by ordinary

care during this period. All that it is necessary to do is to wash out the eyes at intervals and to keep them damp, and protected with swabs soaked in normal saline solution.

The **retraction of the eyes** within the cavity of the orbit is a marked feature of the late stages of cholera, and is simply due to the severe abstraction of the fluid from the tissues of the body generally. It is on all-fours with the sunken cheeks and shrivelled features that bulk so largely in the facies of this disease.

At an early stage the **pupils are dilated**; later they are found to be **contracted** (von Graefe). Coste has laid great stress on the prognostic significance of the pupillary reflex; he states that, when the latter is present, the outlook is favourable; and that, when it is absent, a fatal result may be expected.

Vitreous opacities and cataract have been observed as a result of this disease, and it has been suggested that they are due to an implication of the uveal tract; when it is remembered how extensively the whole circulation is affected by the rapid outpouring of the body fluids, it need cause little surprise that the functions of the ciliary body and of the choroid should be profoundly affected in cholera.

Ophthalmoscopic examination.—The retinal arteries are narrowed, and of a very dark colour, due presumably to the concentration of the blood within them. Very slight pressure on the eyeball either causes an arterial pulse, or stops the circulation altogether; this phenomenon is easily explained by the fall in the general arterial pressure, and is also observed after syncope or after severe hæmorrhage. The veins are dark in colour and may show a broken blood column; the movements of small interrupted cylinders of blood in these vessels are said to be reminiscent of the appearance sometimes seen in embolism of the central artery of the retina (von Graefe).

Cholera patients often complain of **misty vision.** It would be surprising if they did not: (1) Any latent hyperopia present will probably at once become manifest under the debilitating influence of the disease. (2) The scanty circu-

lation through the retina must interfere with the normal function of that membrane, reducing its physiologic activity throughout the whole extent of its surface, and especially in its most peripheral portions, where the blood pressure is normally at the lowest level, owing to the distance of the vessels from the heart. (3) The abstraction of fluid from the tissues must profoundly affect the clearness and translucency of the cornea.

Some have laid stress on a post-choleraic conjunctivitis. This is probably due, as already pointed out, to the exposure of the membrane with which we have already dealt. The chronicity of the affection can be readily explained by the lowered vitality of the patient, which persists long after apparent recovery.

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CHAPTER III

DYSENTERY

The literature of the eye complications of dysentery is of very recent growth, and the great bulk of the most valuable part of it has appeared within the last five years. Vossius, writing in 1904, drew attention to the rarity of eye affections in dysenteric cases, and stated that the following had been observed: Cycloplegia, optic atrophy, and inflammation of the lachrymal glands. He then proceeded to give details of a case in which, in the third week of an attack of dysentery, there supervened prostatic pain and purulent urethral discharge, free from gonococci, but containing numerous *B. coli*. Some days later, double conjunctivitis appeared with *B. coli* in the discharge; kerato-irido-cyclitis supervened; later, pains came on in one knee joint; after three months the patient recovered full vision. Vossius drew attention to the resemblance between the irido-cyclitis in this case and that seen in other acute infectious diseases, *e.g.*, relapsing fever, flue, and gonorrhœa; but the significance of the joint affection would appear to have escaped him. The same year Houdart published the notes of a man of thirty-four, who had been invalided from China for dysentery, with what was obviously an amœbic liver abscess; irido-cyclitis and panophthalmitis supervened, and the second eye was lost by sympathetic ophthalmia. It is noteworthy that pus obtained from the anterior chamber contained staphylococci and streptococci.

Garrod, in 1890, described dysenteric arthritis and stated that this condition was recognised in the eighteenth century, and that it is far more common in some epidemics of the disease than in others; it is especially liable to occur

in the milder cases, and appears when the dysenteric symptoms are on the decline, or even as late as a month after complete recovery. The knees are most commonly affected, but several joints may suffer at once. He made no reference to eye complications in the course of this description, but he rectified this omission in an article he wrote, in 1907, for Allbutt and Rolleston's *System of Medicine*, where he alluded to a case recorded by Salle in 1903. In this, *B. coli* was found in the conjunctival discharge from a patient suffering from dysentery and conjunctivitis. He pointed out the resemblance between dysentery and gonorrhœa, in that in both of them, the joint lesions may be accompanied by neuralgias, such as sciatica, and by conjunctivitis.

Osler, in his eighth edition (p. 128), mentions that in certain epidemics of bacillary dysentery, joint swellings are very prevalent, and are analogous to those met with in gonorrhœal arthritis, but he does not mention iritis. In Osler and Macrae's *System of Medicine* (1907), Markwald is quoted as reporting acute conjunctivitis, iritis, and prostatitis as rare complications of bacillary dysentery.

In 1912, Browning published the notes of a man who had been invalided from China, and who was suffering from bilateral irido-cyclitis, and arthritis. A bacillus of the Flexner type was found in his fæces; vaccines were made from this organism, and the eye and joint conditions rapidly improved under their administration.

In 1916, Fiessinger and Leroy reported the appearance of a conjunctivo-urethro-synovial syndrome, in a series of cases of bacillary dysentery, which occurred in the Somme area, during the autumn of that year. They found that this syndrome presented itself between the tenth and twentieth days of the disease; that the conjunctivitis was more often unilateral than bilateral, and that it lasted about forty-eight hours. They examined the conjunctival and urethral secretions, without finding gonococci or any other micro-organism.

Morax (January 1917), in an epidemic of 250 cases of dysentery of presumably bacterial origin, met with eye

symptoms in one patient. About a fortnight after the dysentery commenced, conjunctivitis appeared in both eyes; a week later, there was rheumatic pain in the feet, knees, elbow, and sternum; 35 days after the dysentery began, there was iritis in the right eye, followed by two relapses, which synchronised with increases of temperature. He further mentioned the case of an officer from Salonika, who made a good recovery after a violent attack of iritis in one eye, following dysentery. He regarded the articulo-ocular syndrome of dysentery as analogous to that met with in gonorrhœa.

In the same number of the journal in which the above appeared, Cosse and Delord reported 8 cases of conjunctivitis during the course of an epidemic of bacillary dysentery, at Chartres, in the summer of 1916. They divided the cases into two groups—(1) Those accompanied by affections of the joints. In these the dysentery was severe; the conjunctivitis appeared about the 15th day of the disease and lasted 8 to 10 days; the joints were affected simultaneously, the knees and ankles suffering most commonly and the shoulders and elbows comparatively rarely; the joint affections lasted for weeks. Sometimes the rheumatism preceded the conjunctivitis; sometimes the enteritis was cured before the conjunctival and articular symptoms appeared; once the conjunctivitis anticipated even the diarrhœa, and on two occasions it preceded the rheumatism. Both eyes were affected, and the inflammation was confined to the palpebral conjunctiva, its incidence being heaviest on the lower lids. After sleep the eyes were gummed by exudation. No follicles or granulations appeared; the glands were not involved, and recovery ensued without treatment. In one case, peripheral keratitis with ritis complicated the conjunctivitis. (2) The second group consisted of 4 cases of an altogether milder type: There was no joint trouble; the conjunctivitis was wholly confined to the lower palpebral segment; it first appeared 5 to 12 days after the beginning of the dysentery, and it underwent spontaneous cure in a week or less. The secretion was very scanty.

By far the most important contributions to our knowledge of the subject lie to the credit of British ophthalmology, as a result of the work done by Kiep and Maxwell, in the Mediterranean area, during the Great War. These are embodied in one joint and two separate papers. Their conclusions will be briefly summarised, but the original communications are well worthy of careful study by all who are interested in tropical ophthalmology.

Maxwell has had 6 cases of dysenteric conjunctivitis under her care, of which 5 at least were bacillary ; 4 were accompanied by arthritis, and 3 of the latter showed anterior uveitis. The attacks of conjunctivitis lasted 5 or 6 days. She mentioned that "in a recent publication on dysentery in Malta, Major Graham, R.A.M.C., pointed out that some of these cases of conjunctivitis may readily be accompanied by a mild, and therefore difficult to diagnose, cyclitis."

Kiep, in his latest paper, deals with 19 cases of uveitis seen by Maxwell and himself. Of these, 10 suffered from Shiga infection, 2 from Flexner, 1 from a mixed Shiga and Flexner, and 1 from a mixed infection of Shiga and another bacillus, possibly Morgan's ; in 5 the type of infection could not be ascertained. Fifteen of the cases developed arthritis, and 1 had an urethral discharge lasting for two days, but no gonococci were found. Of the 19, 18 contracted their dysentery in the Balkans, at least a month before they came under observation at Malta. The first appearance of unequivocal signs of uveitis varied in different cases, the earliest date being the 25th day, and the latest the 37th, with *the* 31*st as an average.* He points out that these figures agree with those of Vossius and Morax, as in their cases the day of incidence of the uveitis was the 34th and 35th days respectively.

In 13 of the cases, the uveitis was bilateral, and in 6, only one eye was affected (Figs. 111 and 112). The initial attack of arthritis, in this series, manifested itself from the 10th to the 32nd day of illness, the *average date of onset being the* 18*th day.* Graham found that nearly

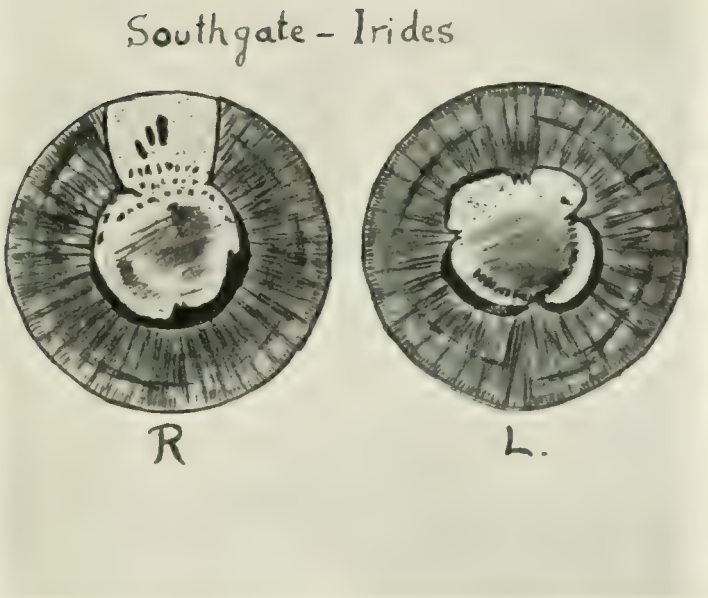

FIG. 111.—The Results of Bilateral Dysenteric Iritis. An iridectomy coloboma is seen in the right eye. (Photo kindly supplied by Major W. Kiep.)

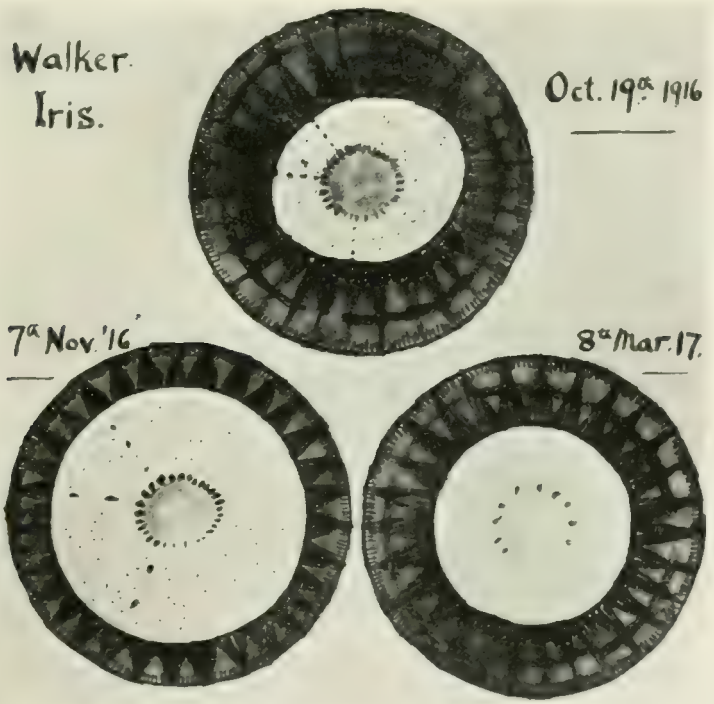

FIG. 112.—The Progress of a Dysenteric Iritis (one-sided), showing the results of treatment. (Photo kindly supplied by Major W. Kiep.)

all his cases developed their articular manifestations between the 8th and 20th days, but in 1 case it appeared as early as the first, and in another as late as the 30th day. The knee, in Kiep's series, was affected about four times as often as any other joint. Then in order of frequency followed the wrist, the elbow, the ankle, the shoulder, the hip, the joints of the hands, and, least often, the joints of the fingers, of the heel, and of the toes.

Even in the slighter cases, uveitis lasted the best part of a month, and in those patients in whom extensive adhesions of the iris to the lens capsule had taken place, the hyperæmia and photophobia persisted for 2, 3, or even 4 months. He knew of relapses occurring in at least 2 of the cases. One patient, with Flexner infection, had had, over a period of 2 years, at least 5 relapses, 4 of them occurring in the right eye and 1 in the left. Another patient, also with Flexner infection, had developed 3 relapses in 14 months, the left eye being affected in 2 of them and the right in 1. In both these patients the original ocular affection had been bilateral.

It has been left to Luna to publish the first case affording definite and apparently satisfactory evidence, that iritis may be met with as a result of amœbic dysentery. A girl of 18, "without any pathologic past," was attacked by "dysentery of medium intensity," the symptoms of which yielded to local treatment within a week. On the fourth day of convalescence she developed eye symptoms; three weeks later, when Luna first saw her, she presented the signs of a moderately acute case of plastic iritis, with posterior synechiæ. The usual symptomatic treatment broke down the adhesions, but failed to stop the inflammatory process, and as the intestinal secretions showed the presence of large quantities of amœbæ (*Entamœba histolytica*), injections of emetin were begun, whilst the local treatment was continued as before. Luna began with 0·08 cgrm. of emetin hydrochloride, and daily increased the dose by 0·02 cgrm. until the patient was taking 0·12 cgrm. daily without inconvenience. After the first injection an improvement was observed; on the third day the left eye seemed clear

of trouble, and the fæcal matter showed a great diminution in the number of amœbæ present. Two days later the right eye had followed the left, and was free of symptoms. Local medication was suspended, and the examination of the fæces for the organism, now proved negative. The happy result was maintained, and the patient recovered, without any further return of her trouble. The publication of this very interesting and instructive case should lead tropical physicians to watch their cases of amœbic dysentery with greater care than ever, especially in view of Houdart's case already mentioned ; indeed it may safely be prophesied that similar records will before long be added to this one. We all of us only too often fail to observe what we are not on the look-out for. In future, forewarned should be forearmed.

Garrod's remarks on the patchiness exhibited by the arthritic complications of dysentery would appear to apply equally to the morbid ocular phenomena met with in the disease. One epidemic may be comparatively rife with the latter, whilst another may not present them at all. It is for this reason that it has seemed well to the author to give the experiences of the authors above quoted at some length.

Kirkpatrick, when analysing his cases of optic neuritis in Madras, observed a high rate of histories of past dysentery, and has suggested that a certain number of inflammations of the optic nerve are directly due to this disease. He adds, "it (dysentery) is sometimes the cause of an iritis or cyclitis, and occasionally of a spot of exudative choroiditis."

Some writers have laid stress on the corneal complications of dysentery. It must always be borne in mind that any debilitating disease, or, indeed, any factor which materially and unfavourably influences the nutrition of the body at large, is apt to be associated with various forms of keratitis and corneal ulcer. Moreover, the predisposition to these unfortunate conditions is very great in the countries where dysentery is rife. There is no reliable evidence that any closer connection than this exists between

dysentery and corneal complications. Most of what has been written under this head, in dealing with the eye complications of malaria, would apply equally well to dysentery, and need not be repeated at length in this place. The reader is referred to the chapter in question.

Pathology and Ætiology.—It will be clear from the preceding pages that this articulo-ocular syndrome of dysentery has hitherto been almost exclusively met with in the bacillary cases, although there is reason to believe that it does occur, if rarely, as a complication of amœbic dysentery. Unfortunately, in a number of the older cases the bacteriological examinations were not of a nature to carry conviction as to their reliability.

The next problem which presents itself, is that of the *exact method of causation* of the eye affections. On no occasion have dysentery bacilli of any kind been recovered from the aqueous, the iris, or the conjunctiva of a patient. In Kiep's two cases, in which it was possible to investigate the contents of the eye by bacteriological methods, staphylococci were found in both ; in one of them streptococci occurred as well. In considering the possibility of these findings being the result of contaminations, we must bear in mind (1) that Houdart found both staphylococci and streptococci in the pus from the anterior chamber of his case ; and (2) that these organisms have sometimes been recovered from the joints of patients suffering from scarletinal arthritis. In any case, we just admit that up to the present there is not a particle of evidence that the inflammation, either of the conjunctiva or of the iris, is caused by the actual presence of dysentery bacilli in those structures.

On the other hand, the fact that the obstinate uveitis disappears rapidly when the patient is subjected to treatment with anti-dysenteric sera, points clearly to a specific influence exerted by the bacilli on the tissues affected. The suggestion would appear to be that circulating toxins are responsible for the mischief set up in parts far distant from the bacillary focus of infection.

It remains to discuss Maxwell's suggestion, that the

Gram-positive organisms which have been discovered within the eye have found an entry through a dysenteric lesion in the intestine. She reminds us that iritis is not uncommon in sub-acute rheumatism, and that in these cases the streptococci present in septic conditions of the digestive tract, are open to the suspicion that they are the causative agents of the uveitis. She further suggests that streptococci may have a predilection for the uveal tract.

The resemblance of the articulo-ocular syndrome met with in dysentery, to that of gonorrhœa, has struck a number of observers, including Vossius, Garrod, Kiep, and Maxwell, but all are agreed that the exact connection between the main affection and the eye and joint symptoms is still wrapped in mystery.

Prognosis.—The outlook in these ocular complications of dysentery would appear to be distinctly favourable, but it is quite clear, even from Maxwell and Kiep's short experience, that relapses are very liable to occur, and even to recur. It is therefore possible that time may modify our opinion as to the favourable outlook in some, at least, of these cases.

Treatment.—The treatment of the eye complications of dysentery requires no elaboration. It is the ordinary routine management of cases of conjunctivitis, iritis, and irido-cyclitis, with the obvious proviso that the original disease must be attacked with the most active therapeutic, and other means at our disposal, not forgetting the administration of suitable vaccines. Indeed, it is probable that the use of auto-genetic antigens furnishes the shortest road to a definite cure of the eye conditions.

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CHAPTER IV

LEPROSY

Leprosy is a chronic, infective disease caused by the *B. leprœ*. Its method of infection is unknown; its period of incubation is probably to be reckoned in years. It begins with ill-defined prodromata of malaise and irregular febrile attacks, associated with excessive sweating, somnolence, perversions of sensation, epistaxis, nasal and other troubles; later, rashes appear and the general health improves for the time being; then follows the period of specific deposit, which may occur either in the skin, determining the nodular or tubercular character of the attack, or in the nerves, producing nerve or anæsthetic leprosy, or in both, when we have the mixed disease. Later still, we have the period of sequelæ, characterised by ulcerations, pareses, and trophic lesions. Cures, even partial ones, are few and far between, and the curtain drops on the death of the patient, either as the result of exhaustion, or hurried forward by some intercurrent disease. The above is but a bare summary of a large subject, and the student, who would rightly understand the eye complications of leprosy, must first make himself acquainted with the phenomena of the disease as found in the body generally, since the ocular changes are but a part and parcel of those wider ones, and have no mystery of their own.

While all writers agree as to the great frequency with which the eye is affected in leprosy, their statistics vary very widely when it comes to matter of detail. Thus, according to Stitt, "it is usually stated that in Northern climates nodular leprosy forms about 70 per cent. of the cases, while in the Tropics the larger portion is made up of nerve leprosy."

On the other hand, a classification of 239 lepers in the hospital at Manilla showed 97 cases of nodular, 42 of nerve, and 93 of mixed leprosy. Manson, without committing himself to definite figures, states that the nodular form is commoner in cold, damp climates, the nerve form in warm, dry climates. The influence of the element of uncertainty, thus revealed, on our estimate of the reliability of the more detailed statistics of the disease is at once obvious.

Then again, as to the incidence of eye complications in the different forms of leprosy : Lopez found in Havana, that every single case of leprosy showed some lesion of the eye or of its appendages at some part of its course. Chance quotes Borthen as having found the eyes affected in 75 per cent. of the anæsthetic cases, and in 90 per cent. of nodular ones in Norwegian lepers, whilst Kaurin, working in the same country, found that from two-thirds to three-fourths of the lepers presented evidence of ocular lesions. On the other hand, De Silva, in Siam, saw only 101 cases of affected eyes in 500 lepers, and Neve in Kashmir found ocular complications in 20 out of 80 lepers in the State Leper Asylum. Stitt's figure for the nodular form coincides with that given by Borthen, but he varies widely from that writer in his estimate of the frequency of these complications in anæsthetic leprosy, for he places it at only 45 per cent. Chance states that " the incidence of ocular symptoms bears no relation to the duration of the general disease, but may come on at any time in its course ; although it is not usually found till several years have passed." Morrow and Lee, on the other hand, in commenting on the frequency with which the eye is involved, say that such involvement occasionally occurs quite early in the disease. It is obvious that no hard and fast rules can be laid down for the disease, and that, on the contrary, there is much individual difference in its behaviour, under the widely different conditions which prevail in various countries and climates.

Clinical Course and Symptoms.—It is necessary to consider the nodular and nerve forms of leprosy separately, in order to have a clear comprehension of the distinguishing

features of each ; but it must always be borne in mind that the two conditions very frequently occur in the same patient.

The Adnexa of the Eye.—Leprosy attacks the eyebrows and eyelids with great frequency ; indeed, according to Lopez, two-thirds of the affected suffer in this way.

In *nodular leprosy*, the skin of the lids and brows is quickly invaded by the tubercles of the disease. The lids follow suit at a later date, their intermarginal portions being first infected ; there may be a diffuse infiltration, or one or more nodules may make their appearance ; rarely these may be polypoid. Falling out of the eyebrows and eyelashes is a very early and very characteristic sign ; often before they actually drop, the hairs become white and downy, or splintered, or moniliform. Later, the forehead becomes deeply wrinkled, the eyebrows are changed into prominent, irregular, hairless rolls ; the nose is broadened and disfigured with knobs, and nodules, separated by deep furrows, form in the glabellum ; the lips are thickened and deformed, the cheeks are irregular, indurated and discoloured, and the ears and chin are swollen and distorted. All this gives a threatening, scowling aspect to the deeply sunken eyes (Montgomery). The expression thus bestowed on these unfortunate people, is usually described as "leonine," and the condition is spoken of as "leontiasis" (Figs. 113 and 114). The nodules which form in the skin of the lids seldom attain a large size, and very rarely ulcerate (Neve).

In *nerve leprosy*, the characteristic, anæsthetic patches in the skin, differing slightly in colour from the surrounding parts, are found at an early stage in the lids and brows, just as they are in other regions of the body, and are associated here, as elsewhere, with degenerative changes in, and loss of, the hair of the parts. At the same time the cornea and conjunctiva lose their natural sensitiveness and become anæsthetic ; the consequent loss of the usual reflexes deprives the front of the eye of the protective movements of the lids, and thus exposes the parts to continuous damage from dust, wind, and other sources,

FIG. 113.—Advanced Nodular Leprosy. (Photo kindly supplied by Dr. L. W. Sambon.)

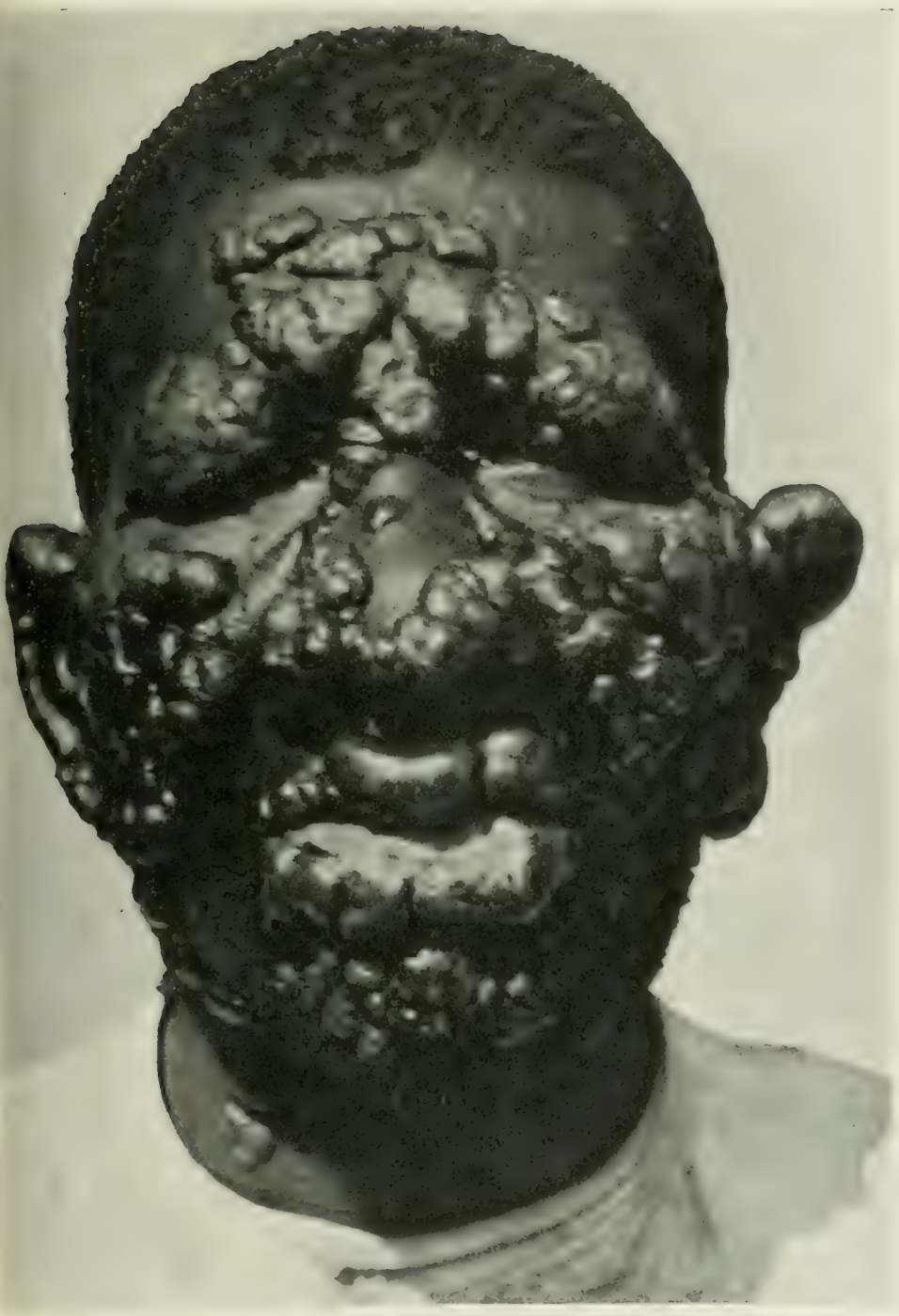

FIG. 114.—Advanced Nodular Leprosy. (Photo kindly supplied by Dr. L. W. Sambon.)

Another possibility, which we cannot afford to leave wholly out of our reckoning, is that the extensive nerve lesions of this disease may directly and unfavourably influence the nutrition of the important parts of the front of the eye, by withdrawing the control of the normal metabolism of the parts. Owing to the lesions in the nerves and to the con-

FIG. 115.—Anæsthetic Leprosy. Notice the paresis of the left side of the face, and the wide-open eye. (Photo kindly supplied by Dr. L. W. Sambon.)

sequent muscular atrophy, characteristic and most unfortunate changes occur. The orbicularis palpebrarum seems to be particularly liable to attack (Fig. 115); after a time the eyes cannot be closed, the lower lid becomes atonic and drops away from the eye, thus leading to an overflow of the tears; the ectropion so produced is extraordinarily frequent: much more rarely entropion is present instead, due to cicatrisation. Another factor influencing the epiphora is the occlusion of the lachrymal duct as the result of

chronic inflammatory processes therein (Honeij). The upper lid may droop, and paralysis of the extrinsic muscles of the eye may lead to deficiency in the movements of the organ, or even to its complete fixation. At an early stage, we may meet with excessive lachrymation, which is usually ascribed to the exposure of the cornea, consequent on the failure of closure of the lids; later, the secretion of the tears dries up, with markedly injurious results for the cornea and conjunctiva, whose epithelial layers become hypertrophied owing to the withdrawal of their natural protective influences in the manner above indicated. The menace to the eye is thus a fourfold one, which we may tabulate thus—(1) The loss of the natural sensitiveness of the organ, with consequent abrogation of the protective movements of the lids; the conjunctiva is thus exposed to the bites of mosquitoes, the invasion of flies, and the dangers of injuries by foreign bodies; (2) the loss of nutritional control as a direct result of nerve lesions; (3) the exposure of the eye, due to muscular pareses of the lids; and (4) the grave diminution of the normal tear-lavage and the consequent drying up of the conjunctiva and cornea. The changes which follow in leprosy might easily be predicated on ordinary physiological considerations. The exposed membranes become dry and chronically inflamed; there is a hypertrophy of the epithelial lining of the parts, and pterygia appear in the palpebral aperture. Later, there is an atrophic shrinking of both the conjunctiva and cornea; the latter membrane becomes ulcerated, leading to the formation of leucomata; still later, perforation, with the loss of the globe, may supervene.

In seeking for an explanation of the early lachrymation and the later xerosis, it is important to bear in mind the excessive general sweating that characterises the early stages of leprosy, and the dry nature of the cutaneous patches of the disease, once they are declared. The features of the unfortunate lepers are, in one way or another, twisted out of shape, as the result of cicatrisation and of the paralysis and muscular atrophy, which follow involvement of the nerves of the eyes and face. The

appearance they thus acquire is as revolting as it is characteristic.

The Conjunctiva and Cornea.—The former membrane may be infected in *nodular leprosy* in a number of different ways —(1) By continuity with the growths which start in the intermarginal edges of the lids ; this is said to be the most common form of attack ; (2) by the development of tubercles in the limbus ; a granular appearance is thus produced, which is in no way characteristic of leprosy ; consequently the diagnosis must rest on the whole clinical picture presented ; it is said that these nodules extend into the sclera only at a late stage of the disease ; (3) by the development of episcleral nodules which invade the conjunctiva on the one hand, and the sclera on the other ; their advance in the deeper plane is long held in check by the denseness of the sclerotic tissue, but slow and steady progress is made along the spaces which surround the blood and lymph vessels.

The cornea, too, is open to attack in different ways in nodular leprosy, and at least three distinct forms of keratitis have been recognised—(1) The so-called *lepromata* or masses of infected granulation tissue, *which spread in from the limbus*, and make their way on to the cornea. These either commence in the limbus, or else are extensions of the infiltrations of the conjunctiva with which we have been dealing ; usually, they first attack the outer peri-corneal region, and from this area they extend circumferentially around the limbus ; as a rule, however, the inner margin of the cornea is spared, whilst the rest of the membrane is surrounded by a low rampart of the new tissue ; at the same time, the growth spreads in, in the form of crescentic opacities, which pass over the periphery of the cornea and make their way towards its centre, developing nodules in their course ; they may cover the whole of the membrane, and may infiltrate it deeply, but the central portion often remains free for a long time. The appearance is often suggestive of masses of new growth. There is a tendency for both eyes to be somewhat symmetrically affected. A feature which compels the attention of all observers is the

retention of comparatively good, and certainly of useful sight, in a very large number of lepers, in whom, judging from the appearance observed, blindness, or at least very defective vision, might have been anticipated. (2) *A superficial punctate keratitis.*—In this form, small grey nodules appear in the periphery of the clear cornea and gradually spread, not only toward each other, leading to coalescence of the areas, but also toward the centre of the membrane; it need hardly be pointed out that the latter form of progress leads in time to the obscuration of that part of the membrane, which corresponds with the pupil, and thus greatly diminishes the patient's power of vision. In a case of this affection, reported from Fuchs' clinic by Meller, both corneæ were studded with innumerable, sharply circumscribed, intensely white dots, situate just beneath the epithelium. The examination of removed portions of the tissue showed these spots to be filled with clumped lepra bacilli mingled with round cells. (3) *A deep interstitial keratitis*, secondary to an irido-cyclitis, and dependent upon the spread of the infection from the ciliary body and along the deep episcleral vessels. The evil effects of this deep-seated keratitis are permanent. The leprotic process in all its forms easily destroys Bowman's membrane, but is long resisted by the corneal lamellæ, whilst Descemet's membrane defies its attacks for a still further period, though in the end perforation may take place with all the dangers that follow in its train.

Whatever the form it assumes, and whatever the structures it infects, leprosy is chronic in type and unrelenting in character. This is as true of its attacks on the conjunctiva, the cornea, and the other parts of the eye, as it is of its invasion of any or all of the remaining structures of the body.

The dangers to which the cornea and conjunctiva are exposed in cases of *nerve leprosy* are not less real than those we have been describing as manifestations of the nodular form. They differ, however, from the latter in two respects—(1) Their progress is slower; it has been reckoned that the course of a nerve leprosy case lasts

eighteen years, whilst one of the nodular form is over in half that time or less ; (2) the troubles met with in the nerve type are mainly the secondary results of the exposure of the eye, due to the removal of the normal protective influences of the healthy parts which surround it. This subject has already been discussed under the heading of the adnexa of the eye, and a repetition of the facts seems unnecessary.

The Iris and Ciliary Body.—The statements of different writers as to the frequency with which the iris is affected in leprosy, vary to such an extraordinary degree as to lead to the conviction that great variations must exist under different conditions of observation. Lie denies that isolated leprotic nodules ever occur in this membrane, but believes that there is a general infiltration of it with leucocytes and bacilli, the infection spreading from the ciliary body. Stitt, on the other hand, states that the presence of nodules in the iris is of common occurrence in the disease. Other writers take up all intermediate positions in their views, a variety of adjectives being used to express the grade of frequency or rarity with which each individual thinks this complication is encountered. The same difference of opinion occurs, but to a very much less extent, with regard to the ciliary body. All are agreed that it is attacked by leprosy, and a good many of the writers speak of it as being especially susceptible. A long-standing irido-cyclitis may lead to loss of function and to shrinkage of the eye, altogether apart from corneal perforation. The distortion of the globes added to that of the lids and conjunctivæ combines to give the leper the loathsome appearance for which he is notorious.

Yudkin's observations are of sufficient interest to justify their reproduction at some length. He says: "The most important lesions of the iris are nodules and iritis. The nodule may develop at any part of the iris, but probably the most favourable place is at the iris angle, or at the circulus iridis major. The iris was the seat of leprous manifestations in half the cases studied by Espada. Besides a serous iritis, he observed a special form, in

which the colour of the iris was not affected, and in which numerous greyish points, about the size of a pin's head, were to be observed on its surface, these points being especially abundant in the neighbourhood of the sphincter. In one case, this miliary eruption was not accompanied by any marked reaction; in another the pupillary margin was bound down by posterior synechiæ. In the first case, the signs of iritis were plastic, with the formation of a more or less thick pupillary exudate, and with some loss of sight.

"The ciliary body is often involved, but it is rare to have any acute symptoms on this account, the only sign of cyclitis being deposits of exudate on the posterior corneal surface."

The Lens.—Cataract is not common, but when it does occur, it is either an accidental coincidence, or else is due to nutritional changes, which result from the implication of the ciliary body. Much more commonly, sight is interfered with by pigmentary deposits from the posterior surface of the iris, as a consequence of untreated or insufficiently treated iritis.

Fundus Changes.—Here again we find considerable difference of opinion. Neve, as a result of experience in Kashmir, has expressed a doubt as to whether either the retina or the choroid is ever primarily attacked by leprosy, though he has seen cases of general infiltration of the globe which might have merited the term "pseudo-glioma." He says that the optic nerve is seldom if ever the seat of leprous deposit, but quotes Pollock's statement that the infiltration spreads to the ciliary nerves from the corneo-scleral region, as also to the ora serrata of the retina.

Trantas, on the other hand, found changes in the eye grounds in 68 per cent. of his 81 cases. In 26 of them, the anterior part of the retina showed small white dots, which sometimes coalesced into larger spots; these were only brought into view by digital pressure over the ciliary region. Farther back in the fundus, he found extensively pigmented spots. On examination, the anteriorly situated retinal lesions were found to consist of a thickening of

the inner layer of the retina with some cell infiltration and with proliferation of the granular layers.

Lopez, too, found retinal and choroidal lesions in advanced cases of leprosy, but not in the early ones, an observation with which others appear to agree.

Visual Fields.— De Silva, in Ceylon, examined the majority of his leprous cases without being able to discover any abnormality either in the visual fields or in the colour sense. He also is responsible for pointing out that the tension of the eye in lepers is only affected secondarily, if at all.

The Lymphatic Glands.—In all forms of leprosy the lymphatic glands in the affected areas are found to be hard and swollen. On section, they present a yellowish surface, due to an infiltration which contains numerous bacilli and globi (Manson).

Method of Infection and Bacteriology.—While the lepra bacillus of Hansen is generally conceded to be the specific cause of the disease, its route of entry is quite unknown, and many important questions concerning contagion are still unsettled. The weight of evidence is against the view that the disease is spread by direct inoculation, as, with one very doubtful exception, experiments in men and animals have given uniformly negative results. The eye has been suggested as a channel for the primary infection, but there seems no positive evidence in favour of such a view, whilst against it is to be ranged the almost universal experience that this organ is never affected very early, and often only late in the disease. The consensus of opinion is to the effect that the ocular manifestations of leprosy are unquestionably secondary. The possible rôle of insects, as agents in the spread of this disease, is receiving close attention at the present time (Chipman).

Axenfeld found that the cornea, episclera, and anterior part of the sclera, and sometimes the iris and ciliary body, contain foci of millions of bacilli; but he failed to detect them in the choroid, retina, or optic nerve, nor have they been discovered in the lens or vitreous. In superficial punctate keratitis, and in the lepromata invading the cornea,

lepra bacilli are to be found in great numbers; indeed, Axenfeld thought leprous keratitis to be much more common than the clinical reports indicate, for he found bacterial colonies in apparently clear cornea; a similar observation was made by Jeanselme and Morax. In interstitial leprous keratitis, on the other hand, the lepra organisms have not been discovered in the cornea, and it is surmised that these deep-seated inflammations are due to an infiltration of the membrane with toxins, excreted by the organisms multiplying in the ciliary body. It is more than possible that time will modify this opinion.

From the diagnostic point of view, it is not without interest to the ophthalmologist to remember that the majority of leprous sera give a positive Wassermann reaction.

Treatment. — Though many remedies have been vaunted, and have for a time, each in turn, attracted the attention of the medical profession and even attained a large measure of its confidence, it must be confessed with regret that there is no known specific remedy for leprosy. The removal of the patient from dirty and unhygienic surroundings to conditions of cleanliness, fresh air, and good food, is the physician's mainstay. Frequent hot baths are believed to be very important adjuncts to general treatment. At the same time, the ocular complications must be treated on ordinary principles. Conjunctivitis, corneal troubles, and inflammations of the iris and ciliary body call for the exhibition of the usual remedies. Kirkpatrick has seen undoubted improvement follow the injection of guaiacol under the conjunctiva, and strongly recommends this use of the drug. The unfortunate fact that the cause of the disease still remains, greatly reduces the prospect of a happy result from medicinal treatment; nor can the results of surgical interference be greatly relied upon to arrest the process. On the ground that the bacilli do not penetrate scar tissue, some have boldly scarified the pericorneal region in order to prevent an invasion of the ciliary area. To the writer such a procedure appears to stand self-condemned at the bar of the

first principles of anatomy or of surgery. In the case of nodules, spreading on to the cornea and threatening to interfere with vision, Drake-Brockman suggested the division of the corneal margin in order to arrest the disease; his idea was that, inasmuch as the bacilli cannot traverse a cicatrix, an impermeable barrier would thus be set up. It seems doubtful whether such treatment is of any use. Nodules appearing in the conjunctiva or at the limbus have been excised. Treatment by X-rays, by radium, and by similar means has been recommended. When ectropion or entropion is present, a plastic operation may be of considerable value to the patient. In cases in which posterior synechiæ have formed, or in which the pupil is blocked, an iridectomy may be of great value. Neve finds that the exposure-ulceration of the lower segment of the cornea heals rapidly if the eye is kept closed. Honeij has recommended the occasional use of lachrymal probes when the nasal duct is blocked by the chronic inflammatory processes associated with leprosy.

Leprous patients bear operations on the eye extraordinarily well. The writer has been astonished at the admirable results obtained after major operations on globes, which appeared the worst possible material for the purpose, even when the procedure was so serious a one as the performance of an iridectomy to establish a path for vision, or even the extraction of a cataract. Whatever we do, we must bear in mind the unrelenting tendency of the disease to progress; very often the best that the surgeon can hope for is to fight, as it were, a series of rearguard actions, with a view to stave off, or at least to delay, the onset of total blindness.

A serum for the prophylaxis and cure of leprosy is being diligently sought for, and the hope that it may be found is encouraged by the facts—(1) That cases of spontaneous cure are not unknown, and (2) that under favourable hygienic conditions leprosy is sometimes susceptible of arrest and even of cure. One other point in prophylaxis may be mentioned, namely, that patients should avoid spreading the disease by contaminated secretions on fingers, towels,

cloths, etc. The fact that we as yet know very little about the contagiousness of the disease, in no way limits our responsibility for the taking of obvious precautions.

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[1] Yudkin's article contains a very full bibliography, to which the reader is referred for details.

CHAPTER V

MALARIA

Introductory

Manson has said that "the tropical practitioner should approach the diagnosis of all his cases, no matter what, with the idea ever present to his mind that they may be malarial or complicated with malaria." Whilst endorsing this advice as both sound and practical, it is important to combine with it a word of warning. Some observers appear to have fallen into the error of ascribing to malaria every morbid condition, which they have met with in malarious countries, without a sufficiently careful examination of the facts and circumstances of each case. It is to be remembered that there are districts, in which practically every member of the population suffers at some time or other from attacks of paludism; in these parts, it would obviously be unwise to jump to the conclusion that some sign or symptom of disease is of such an origin, until the tests for malaria have given a positive result. The three principal tests are: (1) A definite periodicity in the recurrence of the phenomenon; (2) a strong tendency for it to yield to treatment by quinine; and (3) the presence of the malarial parasite in the blood of the patient, and preferably in the tissues of the organ affected. It is obvious that the latter part of this last test cannot always be applied, but there are cases in which it can, *e.g.*, in ulceration of the cornea, and where, in individual cases, pathological material is in one way or another made available. To these tests three others of less importance may be added—(*a*) The presence of pigment in the leucocytes;

(*b*) a high count of large mononuclears in the leucopenic stage of apyrexia : and (*c*) enlargement of the spleen.

It would seem to have been too often forgotten that, altogether apart from malarial infection, the conditions which prevail in tropical countries are highly provocative of ocular troubles. The hot dry winds desiccate the protective epithelium of the eye, and tend to cause it to exfoliate ; in this action they are powerfully assisted by the influence of intense tropical light, or glare, as it is usually called, whilst the dust suspended in the atmosphere penetrates far into the conjunctival sac. The influence for harm of *this evil tropical quartette*—heat, glare, wind, and dust—can only be appreciated by those who have lived through the hot weathers of some of these outposts of Empire.

Another factor deserving of mention is that of *tropical debility*. This may be due to a variety of causes. Every European resident in the East knows that his energy and his power of resistance to disease are both appreciably lessened, if he spends several consecutive hot weathers in the plains ; he tends to become anæmic and listless ; he can no longer do a full day's work to his own satisfaction ; minor ailments affect him in a way they never did before, and he is slow to throw them off and to recover his health. When to his other troubles are added attacks of malaria, or dysentery, or both, his powers of recuperation are still further damaged, and he soon realises that it is a question of escaping from the dangers of the climate, or of coming to a permanent rest in an Eastern cemetery. Such a patient is far more likely to be attacked by eye troubles than one in good health, but to label each or all of these as malarial or dysenteric, because they coincide, more or less, with attacks of these diseases, or because they yield to the specific treatment of the original ailment, is unscientific and misleading. Even the periodicity tests may lead us astray, for the times of deepest depression of general health will correspond in some measure with the recurrence of the attacks of these diseases, and for this reason *post hoc*, even though repeated, will not

necessarily be *propter hoc*. In concluding this paragraph, one may remind the reader of a fact well known to surgeons who practise in the West, namely, that many diseases of the eye, and especially those of the cornea, are most commonly met with in the subjects of depressed health. The point need not be laboured further.

Again, the factors which are provocative of inflammations of the cornea, the uveal tract, the optic nerve, and other parts of the eye, are fully as prevalent in tropical countries as they are in Europe. In many of these lands venereal disease of a virulent type is rampant, while the septic foci, which underlie *auto-intoxication*, are, if anything, more frequently met with there than in Europe. To mention one cause of many—the septic condition of the teeth and gums in many natives of the East is, to say the least of it, highly provocative of auto-intoxication. Acting either independently of, or in conjunction with malaria, such factors may determine the onset of a complication in a malarious patient, and yet it might be inaccurate, unscientific, and misleading to label such a manifestation as malarial, and thereby to suggest that it is the direct outcome of the pathologic activity of plasmodial organisms.

Lastly, it must be carefully borne in mind that there has been a great deal of confusion in the past between the symptoms and sequelæ of malarial fever, and those of the drug employed as a specific against the disease. No one, who is well versed in the signs of quinine blindness in all its forms, can make a careful study of the literature of the subject, without seeing the clearest evidence that much that has been put down to malaria should correctly have been ascribed to the toxic action of quinine.

There is a feature of the standard writings on malaria, which must compel the attention of every thoughtful student, namely, the scantiness of references to the eye complications to be found in the voluminous literature of the disease. When one considers the enormous amount of malaria met with in tropical and sub-tropical countries, and with this in mind turns to study the few short para-

graphs devoted to the eye, in the numerous chapters on this disease in such a book as Manson's *Tropical Diseases*, one cannot fail to be impressed by the contrast presented, and to start wondering what can have been the origin of the extraordinary statement, which has been copied from one textbook to another, that "ocular complications occur in 10 per cent. of cases of malaria." The writer had exceptional opportunity in Madras of studying such complications, if they really existed, for both in the town and in the Presidency there is a good deal of malarial fever, and yet he had the greatest difficulty in satisfying himself that malaria attacks the eye at all. In view of the fact that other writers had had a different experience of the disease, he wrote out to Colonel Kirkpatrick, who succeeded him at the Ophthalmic Hospital, Madras, to ask what his opinion on the subject was, and received this reply: "About malaria—I have not been able to assign it as a cause of any fundus disease. I think it sometimes is the cause of vesicular or herpetic ulcerations of the cornea with a dendritic ulcer or some superficially placed interstitial keratitis to follow. Of course this is not a very malarious part, but I think, all the same, we should see diseases of the uvea, retina, or nerve, caused by it, if they were in any way common." Again J. Kirk, who worked in Penang, writes: "My experience, as the result of twenty years' practice in a country where a vast amount of malaria was seen, does not coincide with these authorities"—Poncet and certain surgeons of the U.S.A. —"eye complications in malaria appeared to be rare." He goes on, in a very interesting article, to enunciate very much the same views as those which have been set forth above. His paper is well worthy of perusal in the original.

If we trace the statement as to the occurrence of eye complications in 10 per cent. of malarial cases to its source, it apparently always emanates from Poncet. The writer feels confident that this estimate is a grave exaggeration, and that it is due largely to faulty deductions, based on statistics, gathered without the control of a healthy spirit of scepticism. On the other hand, the much more

optimistic figures, that might be deduced from a study of the writings of most of the older experts on paludism, may also require some modification, and this for two reasons—(1) The ophthalmologist in tropical countries sees comparatively little of patients in the actual attacks of malaria: whilst, on the other hand, the over-pressed physician far more often than not, omits to include a careful examination of the eyes in his routine procedure, when dealing with "fever" patients; it is thus possible that a number of minor eye complications are overlooked. (2) The type of malaria met with in different countries varies considerably; thus it is claimed that in India the percentage of malignant cases is much smaller than that in Macedonia or Africa. The importance of this observation lies in the fact that India has long possessed a highly organised medical service, whose officers have added largely to the literature of tropical diseases. If we assume that eye complications are rare in Indian malaria, and that those with Indian experience have exerted a large, if not a preponderating influence on the current views as to the symptomatology and pathology of the disease, we might be nearer understanding the attitude of those who, working in other parts of the world, differ from the estimates arrived at in the East. It would seem possible that the cause of the difference of opinion lies in the fact that these eye complications are largely, if not wholly, confined to cases of infection by *Plasmodium falciparum*, the parasite of malignant malaria. If this suggestion is correct, it readily explains why Indian observers have so consistently failed to record the intra-ocular hæmorrhages, both large and small, which, on the other hand, have been described as occurring with relative frequency in the patients suffering from malaria in Salonika, in certain parts of Africa, and elsewhere, both during the Great War and previously. Our comprehension of the subject will be made clearer by a study of some of the elementary facts connected with the pathology of malaria.

Quartan malaria has a periodicity of 72 hours, and is due to the infection by the *P. malariæ*; benign tertian

malaria has one of 48 hours, and is due to the *P. vivax*; malignant tertian malaria (sub-tertian) occurs every 36 to 48 hours, and is due to *P. falciparum*. Quotidian malaria is a mixed infection. The sporulation of the parasites is believed to be responsible for the escape of toxins into the blood stream; these toxins are both pyrogenetic and hæmolytic. The hæmolysis reinforces the destruction of the red corpuscles, which is, in the first instance, brought about by the invasion of these cells by the parasites. The phagocytic action of the leucocytes strives to remove and deal with the parasites and their products. Two forms of pigment are found in malarial cases: The black pigment (hæmozoin), which is to be seen both in the blood and in the tissues, is derived from the parasites themselves; whilst the yellow pigment, or hæmosiderin, is found not only in the blood, but also in great abundance in the various tissues of the body, and is not characteristic of malaria, but is found in any morbid condition in which an extensive destruction of the red cells is taking place. In cases of malignant malaria the pernicious symptoms are to be attributed to (1) the extensive destruction of red cells by the parasites; (2) the nature and the quantity of the toxins liberated; and (3) the plugging of the capillaries of important parts by the parasites. This last effect may be due (*a*) to the sporulating parasites acting as emboli; (*b*) to degenerative changes or distension with pigment of the endothelial lining of the capillaries; (*c*) to the large cells containing the parasites mechanically blocking the capillaries; and (*d*) to the tendency of the malignant parasites to agglutinate. Hæmorrhages of various sizes, but mostly small, are frequently met with in malarial post-mortems. Some attribute these to the result of embolic or thrombotic action brought about as above indicated, but Alport believes the condition to be due to degeneration of the lining endothelium of the capillaries, which leads to rupture of the vessel walls, extravasations of blood, and necrosis. In this connection he makes an interesting observation which may be of great importance from the point of view of the ophthalmic complications

of this disease, for he found that the petechial hæmorrhages which occur in the brain are confined to the white matter and to the internal capsule; they never occur in the grey matter. He points out that the white matter has a poor blood supply with delicate capillary walls, whilst the grey matter has a better blood supply with stronger vessel walls.

It is not pretended that these remarks aim at finality. Their object has been to point out certain discrepancies between the statements of different observers, and to endeavour to reconcile the contending views with each other. It seems likely that the Great War has brought us a vast extension of Empire, and it is to be hoped that those who are responsible for the administration of the wide lands added to us, as well as of those we have ruled for a long time past, will adopt a broader and more generous policy toward their medical services. If this dream be fulfilled, it is certain that malaria and dysentery will be among the diseases that will claim a larger share of attention than ever. The ophthalmologist, and still more the physician who can use an ophthalmoscope, will then have great opportunities of setting at rest many of these questions which now divide and puzzle us.

The Ocular Signs and Symptoms of Malaria

The Conjunctiva.—During the periods of pyrexia there is often a marked hyperæmia of the conjunctiva, which is doubtless comparable to the same condition seen in other fevers. In addition to this, these membranes usually present a yellowish tinge, which varies greatly in depth in different cases. This discoloration is doubtless due to the yellow pigment (hæmosiderin) which is let loose in the blood in large quantities, owing to the extensive destruction of the red cells which is taking place. As has been already pointed out, this is in no way characteristic of malaria, but is found equally in any morbid condition in which hæmolysis is occurring on a large scale. In fair Europeans the yellow tint can be equally well seen in the

skin, but in the dark-skinned races it is unable to show through, and appears then to be confined to the mucous membranes, and especially to the conjunctivæ, in which it is well shown up against the bright whiteness of the sclera.

In chronic malaria, especially when of the malignant type, the skin and the mucous membranes, including the conjunctivæ, undergo varying depths of pigmentation; but in this case the staining is due to the presence of the black pigment (hæmozoin) which is derived from the bodies of the parasites themselves, and which is found in great abundance, not only in the blood, but throughout the tissues of the body.

Yet another change is to be seen in the conjunctivæ of malarial cachectics, for in these patients the general and widespread condition of debased nutrition affects the lining membranes of the eyes just as it does the skin, the mucous membranes, and other structures; they thus lose their lustre and tend to look dry and shrivelled. A characteristic touch is added to the picture by the fact that, owing to the absorption of fat, the eyes are sunken and the orbits look hollow.

The Cornea.—Three forms of keratitis have been ascribed to malaria—1. *Superficial Keratitis.*—This has been so widely recognised as a malarial manifestation, that we may probably accept it with but little hesitation. It commences as a herpes of the cornea, but without the appearance of definite vesicles; a superficial ulceration follows, lateral offshoots develop, and the affection passes on to present the characters of a well-marked dendritic ulceration. It is usually accompanied by a good deal of photophobia and lachrymation, and is sometimes ushered in by a severe supra-orbital neuralgia. It is generally believed to be associated with the benign rather than with the malignant forms of malaria. Kipp stated that 9 out of every 10 cases of this affection seen by him had a malarial origin. Kiep found it in a definite percentage of the malarial cases seen by him in Malta. Maxwell, working side by side with Kiep, leant to the same

view as to the ætiology. Of the 44 cases she saw, all were unilateral; the time of incidence from the malarial attack ranged from 1 to 20 days, with the 6th day as an average.

It is to be borne in mind that herpes corneæ has been observed in a number of febrile conditions, and in other states in which the bodily resistance was lowered. Uhthoff, consulting ophthalmologist to the Sixth German Army Corps, reported it as occurring in 1 case out of every 4 of keratitis among troops at the Front; he attributed it to disordered metabolism, following strain and exhaustion.

On no occasion has the malarial parasite been found in scrapings from the corneæ of malarial or other patients. This, of course, does not exclude the possibility that the affection may be due to the action of a specific malarial toxin.

Two things seem to be clear—(1) That there is an association, and possibly a close one, between malarial infection and this form of keratitis; and (2) that we cannot regard the latter purely and simply as a manifestation of plasmodial disease. Other factors must be taken into account; for instance, the influence of sun, glare, wind, and dust, the reduction of the patient's general standard of health, and the effects of pyrogenetic toxins.

In conclusion, it is interesting to call attention to the fact that those, who have spoken of herpes corneæ, of dendritic keratitis, and of ulceration of the cornea, as though they were three different things, have, in reality, probably been dealing with different stages of one affection.

2. *Interstitial Keratitis.*—It may be questioned whether there is any reliable evidence that a true interstitial keratitis is ever caused by malaria. It is well known that a patient, who has a constitutional tendency to this form of corneal trouble, may develop a well-marked attack under the influence of injury or of debilitating disease. Malaria may well fall in the latter class. Another point must be mentioned: A study of the literature strongly suggests that not a few of the cases of keratitis, classified as interstitial, would more correctly be referred to the

category of keratitis profunda, with which we shall deal next.

3. *Keratitis Profunda*, also spoken of as central parenchymatous keratitis, or as deep-seated keratitis, is considered by some writers to occur as a manifestation of malarial cachexia. Arlt and Levrier were among the first to suggest this association. The condition is characterised by the formation of a grey opacity in the deeper layers of the cornea; this is often central and circular, hence the name "discoid" which has been applied to it; the cornea is not vascularised, but circumcorneal injection may be well marked; photophobia is sometimes a troublesome symptom. There is no tendency to ulceration, and secondary uveitis is said to be rare. The course of the trouble is often prolonged; vision is much interfered with as a result of the opacification of the cornea; under magnification, the opacity is said to show fine striated lines and dots. The malarial parasite has never yet been recovered, either from the cornea or from the aqueous, in these cases.

The evidence on the subject, then, would appear to amount to this: In malarial cachectics, a deep-seated and intractable keratitis is at times met with, and improves or passes away under the influence of the ordinary local measures for the treatment of such a condition, combined with the use of anti-malarial remedies. Were it not for the fact that one textbook after another, even reliable works being included in the list, has credulously and unhesitatingly accepted this form of keratitis as a malarial manifestation, it would not have seemed worth devoting more than three lines to the subject. As things stand, the author desires to focus the attention of tropical workers on the question, in the hope that they will shake themselves free from the shackles of a too easily acquired tradition, and will consider the subject without bias, and in the light of their personal experience. Few worse examples can be found of the evil method of copying, which disfigures the majority of textbooks.

The Uveal Tract.—*Iritis*, *irido-cyclitis*, and *choroiditis*

are met with in malarial patients, just as they are in the non-malarial. The depression of the general health, which accompanies attacks of palludism, may obviously constitute an exciting factor in a patient otherwise predisposed ; again, the restoration of health, by improving the general resistance, may banish the evidences of uveal inflammation. It is possible, however, that this does not constitute the whole case. Major H. Edgar Smith, who had a very large experience of malignant malaria during three war-years in Salonika, has kindly furnished the author with his views in a personal communication. He met with some 15 to 20 cases of a low grade iritis, which he was strongly inclined to think were malarial ; they were readily amenable to local treatment, combined with the use of quinine ; they showed exacerbations, which corresponded to rises in the temperature charts ; the examination of the blood proved the presence of malaria, while syphilis, dysentery, gonorrhœa, dental sepsis, and digestive troubles were carefully excluded.

The Retina and Optic Nerve.—*Retinal hæmorrhages.*—From the time of Poncet's writings onwards, it has been generally accepted that retinal hæmorrhages are of comparatively frequent occurrence in malaria. These, apart from the cases of optic neuritis, are said to be of two kinds—(1) Small and peripheral ; and (2) large, and occurring in the posterior pole of the eye.

1. The first are believed to take place during the pyrexial bouts, as a result of the plugging of capillary vessels by parasitic cells, or of changes set up by the parasites in the lining cells of the capillaries themselves. Whatever may be our decision as to the frequency of the occurrence in the eye of these petechial hæmorrhages, we must regard them from the pathological standpoint as being identical with like phenomena in other organs of the body. They would appear to be more frequent in the malignant than in the benign cases. It is possible that they have been often overlooked on account of their situation, and this for three reasons—(1) Being so far forward, they are difficult to see ophthalmoscopically ;

(2) lying, as they do, in the periphery of the retina, there is little chance of their attracting the patient's attention by the setting up of positive symptoms; and (3) a routine examination of the very periphery of the fundus is very seldom made in malarial patients, because, while the attack is on, they are too ill, and as soon as it passes off, they recover their general health too rapidly to call for a minute and prolonged examination of any kind.

If further examination, by reliable practitioners, confirms Poncet's statements as to the frequency of occurrence of these tiny hæmorrhages far forward in the retina, it may furnish an interesting confirmation of Alport's observation, referred to on pages 450 and 451, that the petechial hæmorrhages, which occur in the brain, are confined to the white matter and to the internal capsule, and never occur in the better vascularised grey matter; for, it is well known that the retinal circulation is weaker at its periphery than at its centre, although it has been suggested that it is weakest of all in its equatorial belt.

2. *The larger retinal hæmorrhages*, which have been attributed to malarial influence, are said to occur in the macular area or in the neighbourhood of the disc, and to be associated with the cachexia of malignant malaria. It is stated, and evidently with reason, that they account for some, at least, of the cases of malarial amaurosis. It must not be forgotten that profound anæmia is a characteristic of malarial cachexia, and that, whatever its cause may be, it is frequently associated with a tendency to hæmorrhage in many parts of the body. Why then should the eye prove an exception? On this subject the author would again quote Major H. Edgar Smith: "I saw many cases of retinal hæmorrhages, but (and I have the blood counts of all) I never saw a case with a red-cell count over three millions. I never saw hæmorrhages in a recent case of malaria. In other words, I think the grave secondary anæmia was responsible for the hæmorrhages. Subhyaloid hæmorrhages, I thought, were more prone to occur in the very grave anæmias (under

1·5 to 2 million reds), but I would not insist on that point."

It is to be sincerely hoped that many others will continue investigations on similar lines, as there is plainly a conflict of opinion on the very important subject of the true ætiology of these hæmorrhages.

Optic neuritis.—It is well known that optic neuritis may arise as a result of a number of different forms of general infection, and there would appear to be sufficient evidence to include malaria among the diseases which may cause it. Uhthoff has pointed out that it is most apt to arise during convalescence, and has considered it to be due to the action of toxins, rather than to that of micro-organisms. Maxwell, in her valuable paper on "Eye Conditions in Malta," has recorded her experience of 7 cases of definite optic neuritis, and of 10 more of hyperæmia of the nerve-head in malarial subjects. All were binocular, and defective vision was not complained of in any of them. Bourland's 2 cases of optic neuritis, caused by malaria, are also worthy of study. Many other writers have referred to the subject, and some of them have published individual cases. Yarr states that "the variations in the visual acuity in the course of the malady, form the most characteristic symptom, and distinguish malarial neuritis from all other forms"; he adds, "Sulzer, in an admirable paper on the subject . . . lays stress on this point." Some writers have claimed to be able to diagnose the condition by the dirty, reddish-grey tint of the papilla. Small retinal hæmorrhages are frequently met with in this, as in other forms of optic neuritis. It is stated that optic atrophy sometimes follows neuritis. The possibility of quinine poisoning should be most carefully considered in all such cases of reputed secondary atrophy. Kirk met with a case of retro-bulbar neuritis, which he thought to be of malarial origin.

The Fifth Nerve.—A good deal has been written on the subject of "masked malaria," the most important manifestations of which are reputed to be neuralgias of various kinds. The fifth nerve is said to be most often

singled out for this affection, the frontal branch suffering more often than any of the others. Speculation has been rife as to whether the nerve is invaded by the parasites, or only by their toxins, and much stress has been laid upon the amenability of these forms of neuralgia to treatment by quinine. The parasite most frequently responsible is the sub-tertian. There are, however, certain matters which must be borne in mind before we implicitly accept the suggestion of a malarial ætiology—(1) Keratitis is not infrequently associated with trigeminal neuralgia, and the corneal cause of the trouble is certainly often overlooked. (2) Iritis, whether or not of true malarial origin, is likewise attended by the same form of neuralgia. (3) Many patients, suffering from errors of refraction, or from defects in the muscle balance of the eyes, complain bitterly of neuralgia, whenever their general health is in any way affected. We see this, for example, in every influenza epidemic. It will therefore be readily understood that malaria may be indirectly responsible for the neuralgias, just in the same way as any other debilitating affection may be. One cannot deny that there may be cases, in which the neuralgia is the product of a true malarial neuritis, but it is contended that a little healthy scepticism and a careful survey of the available facts would eliminate many of those which have been accepted in the past.

The Motor Nerves of the Eye.—There is a widespread belief that paralyses of the extrinsic muscles of the eye may occur as a manifestation of malaria. Kirk states that, in his experience, the sixth nerve is more commonly affected than the third or fourth. Though the author is disposed to believe in the malarial ætiology of some of these cases, he feels it incumbent upon him, while directing the attention of tropical practitioners to the subject, to utter a word of warning against the credulous and undiscriminating classification of every case of oculo-motor paresis met with in malarial patients, as necessarily of parasitic origin.

Many other eye affections have been attributed to

malaria. These include exudates into the vitreous, retinal detachment, cataract, etc. Such speculations hardly call for serious comment. To discuss them would be a waste of time and space.

Malarial Amaurosis.—Some writers have discussed at great length the differential diagnosis of malarial and quinine amaurosis. If the cases, in which blindness is due to hæmorrhages, occurring in the central region of the eye, are excluded, it may be questioned whether malaria is ever responsible for blindness. It is quite certain quinine often is. The attention of tropical practitioners is earnestly invited to this subject. Quinine amaurosis will be fully discussed in the next chapter.

Treatment

It is obvious that when any eye condition is suspected to be of malarial origin, specific treatment by quinine and other remedies is indicated. This is true, not only of those cases, in which the condition is believed to be of true malarial ætiology, but equally so in those, in which the trouble is secondary to an impairment of the general health, as a consequence of paludism. It has been contended, that in the treatment of dendritic keratitis quinine is useless unless pressed energetically from the very commencement. Kirk states that "once the disease has a firm hold on the cornea, and degenerative changes have occurred, general treatment does not appear to help, yet it will most certainly do so in the beginning."

The usual symptomatic treatment of the various affections of the eyes must be carried out on ordinary lines.

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CHAPTER VI

QUININE POISONING

The great world war flung masses of young men of the Anglo-Saxon race into parts of the earth, where they were exposed, in an unprecedented degree, to the attacks of malaria and other fevers. As a consequence of this, an unusual amount of attention was focussed on the treatment of these conditions. One of the immediate results was the administration of massive doses of quinine, as a specific for malaria, especially in its malignant forms. How large these doses were may best be judged from the fact that in a recent monograph on the subject Major Alport advised, that, in the first week of bilious remittent fever, 60 to 80 grains of quinine bihydrochloride should be given every day ; in the second week, the daily dose was to be 40 to 60 grains, and in the third week and onward, 45 grains. Again he spoke of 26 cases, treated for 72 days, with average daily doses of 35 grains ; the minimum total quantity, taken by any one case during the period, was 1330 grains, and the maximum 3560 grains.

It is not the author's purpose to dispute that malignant malaria may give rise to a condition of such urgency as to justify the taking of the serious risks, involved in the administration of such huge doses of a toxic drug ; but, he feels that all, who embark on such a course of treatment, should study and know both sides of the question, namely, the advantages claimed by the tropical practitioner, and the dangers that present themselves to the mind of the ophthalmologist. It is with the latter that we are now concerned.

The Dose of Quinine which may give rise to Eye Symptoms.—A study of the reported cases of quinine blindness reveals the most startling variations in the dose of the drug required to produce pathologic phenomena in different patients. One will take a quantity which seems enormous with apparent impunity, whilst another will show failure of vision from a dose, which to the ordinary person would be absolutely innocuous. There are, however, certain factors, which we must take into account, in every case, and we shall deal with these in turn—(1) *The solubility of the salt of quinine employed.*—This varies very widely; thus, the acid hydrochloride dissolves in an equal quantity of water, whilst the sulphate requires 800 parts to bring it into solution, and other salts are intermediate in character. There is reason to believe that the more soluble the salt used, the greater the quinine-content of the blood, and thus the greater the activity of the drug, either on the malarial parasite, or on the tissues of the patient. (2) *The vehicle in which the quinine is given.*—Solutions, and especially spirituous solutions, constitute a concentrated and easily absorbed form for the administration of the drug. On the other hand, stale pills and tabloids may prove practically insoluble in the alimentary canal, whilst large quantities of powder tend to be vomited or speedily evacuated. (3) *The method of administration of the drug.*—It may be given by the mouth, by the rectum, under the skin, into the muscles or intravenously. Obviously the last-named would provide the greatest possible concentration of the alkaloid, whilst in the remaining methods, the blood-content of quinine would depend on numerous other factors. (4) *The total amount of the drug retained in the system.*—When the actual quantity of the drug is known and accurately stated, it is the outside possible dose; but the exact deductions we must make therefrom in order to deduce the quantity absorbed into the circulation are difficult, if not impossible, to calculate. Allowance must be made for vomiting, purging, insolubility, want of absorption, etc. (5) *The individual idiosyncrasy of the patient.*—This constitutes the great risk, beside which all others fade into

insignificance ; it will, therefore, be dealt with separately in the next section. (6) *The age and sex of the patient.*—This probably is very largely a matter of the weight of the subject, since women are, on the average, lighter than men, and children than adults. There seems, however, to be reason to think that women and children are especially liable to quinine poisoning.

The Doses of Quinine which have proved Toxic.—The recorded cases show that these vary enormously. In some of them, the dose is described as huge ; in others, one to several ounces were taken in a few days, or even in a few hours. In still others, and these fairly numerous, quinine poisoning has followed the administration of the drug in quantities varying from 40 grains to half an ounce, whilst in a few patients the personal idiosyncrasy has proved so marked as to lead to alarming symptoms after the ingestion of anything from 10 to 30 grains of the drug. Lastly, there are the highly abnormal cases, in which quinine cannot be tolerated in any quantity however small, and even 2 grains, given by the mouth, may give the physician cause for grave anxiety.

Precautions in the Administration of Quinine.—It has been pointed out that inasmuch as both acid and alcoholic solutions favour the solubility of quinine, they intensify its action. Several cases are on record, in which very serious consequences have followed the free imbibition of spirits after the taking of large doses of powdered quinine. The moral is obvious. Moreover, when using quinine in a highly soluble form, it would seem to be imperative that the physician should not let the action of the drug get out of hand until he is sure that no dangerous idiosyncrasy is present.

The Repetition of the Dose.—It has been proved that the repetition of even small doses of quinine may be dangerous to a patient with an idiosyncrasy for the drug. What is still more important to remember is, that once signs of quinine amblyopia have appeared, there is always reason to fear a liability to relapse after the exhibition of doses of quinine, which in all probability would previously have proved harmless. This last statement is based on

the observations of a number of reliable ophthalmologists. It is, therefore, the more difficult to understand how, in Alport's cases of quinine blindness, the exhibition of the drug, resumed in large quantities as soon as sight had returned, was not accompanied by any return of loss of vision. The author feels himself quite unable to comment on the subject, but considers that attention should be drawn to the facts which have been reported.

Method of Onset and Course of Attack.—These vary greatly in different cases, as might be anticipated, since the size of the dose, the method of taking it, the age, weight, and sex of the patients, are all widely different, whilst last, but not least, looms the factor of each individual's susceptibility to the drug.

The administration of medicinal doses of a salt of quinine gives rise in normal subjects to a train of symptoms, which is so constantly met with, and of such slight clinical significance, that it is best described under the term "cinchonism"; we may reserve that of "quinine poisoning" for the more serious form of the same condition, which may attend the ingestion of large doses, or that of comparatively small doses in very susceptible subjects.

Cinchonism.—Soon after taking quinine, the patient complains of ringing in the ears, deafness, and a feeling of fulness in the head. There may be very severe headache; giddiness may supervene, and the patient may stagger in his walk. He may wish to lie down, and feeling drowsy, may quickly fall asleep. All these symptoms are transitory, and, as a rule, have passed away by the next day, provided the administration of the drug is stopped.

Quinine Poisoning.—The first symptom of this condition to arrest attention is the **onset of partial or complete blindness.** This is often observed after the patient awakes from the heavy sleep, or from the comatose condition, which follows the dose when it is a large one. It is, to say the least of it, probable, that the pathological changes in the eye often precede the observation of blindness by hours, by days, or even longer. When the drug has been more gradually administered, failure of sight may again be the

first sentinel symptom, and its commencement may be noticed even within a quarter of an hour of the drug being taken. The onset of central blindness is so dramatic that it compels the patient's attention, but it is more than probable that every case, if carefully observed, would be found to be heralded by amblyopia and contraction of the visual fields. Where the patient is conscious throughout, the sight may gradually diminish to vanishing point, or, on the other hand, it may flicker out as suddenly as a light does when it is turned off. Some of the cases are merely amblyopic, others are absolutely amaurotic. Then again, the duration of the blindness varies enormously ; it may pass off in a few hours, or may last days or even weeks.

Whether perfect sight is ever restored in severe cases may be open to question. This is a matter largely of the standard of perfection that the examiner sets before him, and of the care with which his examination is conducted.

Alterations in the Light Sense.—It seems probable that a defective light sense is to be found in most cases of patients who have suffered from quinine amaurosis, if only the examination is sufficiently carefully conducted. Not a few of the sufferers complain of the difficulty they experience at night or in the dusk. Their powers of adaptation when they pass from a bright light into darkness or vice versa are painfully slow.

Alterations in the Visual Field.—As the amaurosis or the amblyopia passes away, the patient is found to be considerably hampered by the loss of his peripheral vision. He stumbles over objects on the floor, or has difficulty in finding his way about, even though his central vision may have returned to a normal standard. Even when the dose is comparatively small, and the normal field of vision is rapidly re-established, a late and progressive reduction of the fields may again appear, more especially if the patient ventures to take further doses of quinine. Although various interesting abnormalities may be found in the course of the perimetric examination of these patients, there can be no question that the typical defect observed is a concentric constriction of the whole field.

Alterations in the Perception of Colours and in the Colour Fields.—In those cases in which the central colour vision is tested at a very early stage, it is found to be uniformly deficient or absent. Improvement, however, sets in fairly early in most cases, and in some at least it would appear to become perfect again, though others are much less fortunate. Our knowledge of the state of the colour fields in these cases is scanty, but from the available reports, they would appear to be greatly contracted.

Dilatation of the Pupil.—In the vast majority of cases, the pupils are fixed and dilated, the latter often to an extreme degree. This mydriasis is probably a very early symptom, and is a phenomenon of the greatest importance, since it enables even the unskilled to get a full and easy view of the fundus. The combination of a dilated pupil with the typical ophthalmoscopic appearances should seldom leave a doubt as to the causation of the blindness. As the case progresses, and the patient recovers vision, the mydriasis passes away, and the normal pupillary movements are re-established, but, some enlargement of the pupil may persist permanently, and may be associated with sluggishness in the iris movements.

The Ophthalmoscopic Changes observed. — The most characteristic of these are pallor of the optic disc and extreme contraction of the retinal vessels ; the arteries may be so greatly diminished that they can only be traced a very short distance out from the disc edges. The next most frequently observed sign is that of a red spot at the macula ; the vivid cherry colour found in obstruction of the central artery, is absent in quinine poisoning, presumably due to the fact that there is an ischæmia of the choroid, as well as of the retina, resulting from the action of the quinine on both sets of vessels. Various other rare appearances have been described. These include : Thickening of the walls of the retinal arteries, fundus changes of various kinds indicative of inflammatory action, breaking up of the columns of blood in the retinal vessels, retinal arterial pulsation and phenomena indicative of retinal thrombosis.

There are indisputable cases, both in men and animals, in which quinine amaurosis is present in the absence of any characteristic ophthalmoscopic appearances.

Among the rarer eye symptoms observed are to be recorded the following :—Unilaterality of the affection, anæsthesia of the conjunctiva, sometimes associated with hypotonus, and affections of the muscles. The latter include lid-spasm, paresis or paralysis of ocular muscles, paresis of accommodation and nystagmus.

Aural Symptoms.—It is of interest to record that the deafness of quinine poisoning, which is usually so transitory, may in some cases persist permanently; possibly this occurrence in a mild degree is more common than is usually believed.

General Symptoms.—Very heavy sleep and often a condition of coma may come on, or the patient may merely appear drowsy and stupid. On the other hand, an irritable cerebral condition may be present, characterised by troublesome delirium and visual hallucinations. Want of control over the patient's movements, and also convulsions may be observed. Respiratory embarrassment, cardiac failure, and severe gastro-intestinal symptoms may each and all be present. It is therefore obvious, that it is only too easy to confuse the signs and symptoms of quinine poisoning with those of the various severe fevers for the cure of which the drug is administered. From perusal of the available records, it is clear that this has sometimes been done, with the result that the drug has been pressed at a time when it should have altogether been withdrawn. The tragedy of such mistakes is all the greater in children, in some of whom it would appear, that it took days or longer before it was discovered that the so-called treatment was the real cause of the trouble. These little patients paid by lifelong blindness the penalty of the doctor's errors. Such disasters should be relegated to the limbo of an unforgettable past. Any hesitation as to diagnosis should be banished by an observation of the widely dilated pupils, associated with extreme retinal ischæmia, and failure of vision.

The Pathology of Quinine Poisoning of the Eyes. —There have, from the commencement, been two distinct schools of thought, one of which ascribes quinine blindness to starvation of the retina, as a result of the ischæmia produced by the direct action of the drug on the vessel walls, whilst the other believes that there is a selective toxic action on the cells of the retina. Neither view is by itself wholly acceptable, and the modern tendency is toward a compromise between the two. A certain number of cases are on record, which would seem, at least, to suggest that the cutting off of the blood supply by ischæmia may directly influence the onset of blindness. On the other hand, there is irrefutable evidence, both in men and animals, to show that absolute amaurosis may be present at a time, when the blood vessels are seen ophthalmoscopically to be of normal calibre. Furthermore, it has been pointed out that in ordinary typical cases of quinine poisoning, there is no close connection between the degree of ischæmia and the state of the vision. We must not forget, however, that at a still later stage of months, or even years afterwards, the gradual and apparently permanent restoration of vision is accompanied by some measure of visible increase of the retinal circulation. It has also been pointed out that vasomotor stimulants like ergot, though they produce dilatation of the pupil, blanching of the optic discs, and constriction of the retinal vessels, are not accompanied by the interferences with vision, which are characteristic of quinine poisoning.

Whilst the signs and symptoms of quinine poisoning closely ally the action of the drug with that of the many other toxic substances, which produce amblyopia, there are distinct features which stamp this toxæmia as specific. These are—(1) The complete loss of all vision, sometimes coming on quite suddenly ; (2) the extraordinary recovery of function which may subsequently occur ; (3) the fact that the central vision comes back first, whilst the peripheral vision is recovered more slowly, and seldom, if ever, completely ; (4) that the colour sense is often damaged, and that if it returns, it does so first at the centre, and then

works gradually outwards; (5) that a diminution of the light sense, with resultant night blindness, is a frequent, if not an invariable sequence of these cases. No such syndrome occurs in any other form of toxic amblyopia.

The weight of the evidence would seem to favour the view that, in dealing with quinine amaurosis, we have to do with a specific toxæmia, a feature of which is a powerful selective action. As to the precise nature of the structures selected, we are not yet in a position to pass a final judgment. It is obvious that when any organ is suffering from the effects of a powerful intoxication, the cutting off of its blood supply may become a very important, and even a dominant, factor in the situation. In other words, it is probable that the ischæmia is not the primary, or even the principal, cause of the amaurosis, but it is, none the less, an influence of the gravest possible import, and one of which we must always take account.

Treatment.—The first and most obvious indication is to stop the supply of the drug. There are, however, those who argue that blindness is preferable to death, and that the necessary treatment of malaria may sometimes demand the sacrifice of sight in order to save life. Those who adopt such a position must be careful to ensure that their diagnosis is correct, and that the symptoms which they ascribe to malaria, such as vomiting, headache, delirium, and coma, may not in reality be manifestations of quinine poisoning. They must also satisfy their colleagues that there is no method of effectually treating severe cases of malaria, other than the exhibition of the large doses of quinine, which they advocate.

Once a patient is known to have an idiosyncrasy for quinine, or to have suffered from poisoning by this drug on some previous occasion, it is advisable to avoid the exhibition of any of the cinchona products if possible.

Of the **drugs recommended,** far the most popular of all is *strychnine*, whose action is largely, at least, attributable to direct stimulation of the optic nerve fibres. Next in importance comes the drugs which favour vaso-dilatation, and of these *nitrite of amyl* has been more popular than

nitro-glycerine, though it may be questioned whether the opposite choice would not be more reasonable. A combination of the two drugs might be better still. One observer recommended the giving of two minims of nitrite of amyl twice daily, together with $\frac{1}{75}$th gr. of nitro-glycerine every four hours.[1] Digitalis has been recommended by many, presumably because it increases the force of the heart beat. Other drugs which have been used have been the bromides, the iodides, hydrobromic acid and eserin.

So much for drugs. We may now pass on to **other measures**. Massage, galvanism and the use of suction glasses have been recommended, but there is not much to be said in their favour. The patient should be kept lying down, and his general health should be attended to by the use of vigorous supporting measures, inclusive of a generous diet and plenty of fresh air.

Operative Treatment.—A recognition of the fact that constriction of the retinal vessels plays an important part in the pathology of the condition, has led surgeons to employ drugs which favour vaso-dilatation. If the intra-ocular pressure could be permanently reduced by operative measures from normal to subnormal limits, it seems reasonable to suppose that the flow of blood through the eye would be increased, and that under these circumstances an improvement in retinal function might be anticipated. It was on such lines as these that Mayou recommended sclero-corneal trephining in the treatment of retinitis pigmentosa. The same operation seems worthy of trial in some of the permanent cases of quinine amblyopia, in which the visual defects are associated with severe constriction of the retinal vessels. The way in which contracted visual fields have been found to improve, and this too after the lapse of years, would seem to indicate that something might be done even in very late cases.

Those who are interested in the subject of quinine poisoning will find it much more fully dealt with in an article written by the author in the *American Journal*

[1] The author has recently used this treatment with apparently very satisfactory results.

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A full literature ot the subject is appended to the author's article in the *Amer. Jour. Ophth.*, September 1918, pp. 656–658.

CHAPTER VII

PELLAGRA

Pellagra is an endemic disease which develops slowly, and is characterised by a series of symptoms which involve chiefly the digestive, cutaneous, and nervous systems. These first appear during the spring months, and recur annually at this season, while tending to remit during the winter. It is almost confined to field labourers. Its distinctive features are—(1) A remitting dermatitis of the exposed parts of the body; (2) the development of marked emaciation; (3) profound mental depression alternating with mania; and (4) certain well-marked eye changes.

Lorenz compares the mental state of pellagrous patients with the toxic psychoses, and especially with alcoholism. He states that the resemblance is not merely a clinical one, since the character of the degenerative changes, found in the nerve cells of the brain, are similar in both conditions. Dunlap found axonal degeneration of the cortical nerve cells, a change which has likewise been found by Spiller in chronic alcoholism. It is said that in the absence of a clinical history, the pathologic evidence alone is insufficient to decide whether a case is one of pellagra, of centraic neuritis, or of alcoholism.

It is generally believed that the disease is a form of toxæmia, and the prevailing view is that the poison is in some way derived from unripe or spoilt maize, the suggestion being that certain chemical toxins are liberated under unfavourable conditions, and that these are responsible for the symptoms of pellagra. Sambon, on the other hand, has contended that pellagra probably belongs

to the protozoal group of diseases, that it is insect-borne, and that the intermediate host is some form of blood-sucking midge, belonging either to the chironomidæ or to the simuliidæ (Fig. 116).

The Eye Signs and Symptoms.—None of these is pathognomonic of pellagra, but the number and variety of those which have been ascribed to the disease are surprising. They include asthenopia, circulatory changes in the retinal vessels, nyctalopia, amblyopia, optic atrophy, cataract, and various pareses. Amongst the latter may be quoted diplopia, mydriasis, and ptosis. Whaley has contended that the drooping of the upper lid is not paretic, but is due to the patient's desire to avoid the light; he says that on raising the head, the lid may droop still lower, but that if the patient can be induced to look up, he has no need to throw back his head to get the lid out of the line of sight. He found the pupils often unequal, sometimes bilaterally dilated, but generally smaller than normal, and presenting a diminished light reaction. Cataract, and especially juvenile cataract, is said to be much more common among pellagrins than among other people of a corresponding age. Observers appear to be in agreement, that the severity of the eye symptoms runs closely parallel with that of the general manifestations of the disease, and that marked eye changes are of serious prognosis, indicating the probability of an early, fatal termination of the affection.

Fig. 116.—Simulium nigrogilvum, imago. A species of an order which has been accused of transmitting the causative organism of pellagra. (*ex* Manson's *Tropical Diseases.*)

Calhoun has shown that in most cases of pellagra, there is a contraction of the field of vision for form and colour; this is frequently associated with an interlacing

or misplacement of colours, especially of the green and red. In a relatively large proportion of the cases, he found a scotoma for red and green and occasionally for all colours. These scotomatous areas were not necessarily confined to acute or to well-marked cases; indeed, he observed them in two patients, even before a diagnosis of pellagra had been otherwise made. He considers that we must leave open our answer to the question, whether the disturbance in the visual fields is due to central changes, or to a toxic alteration in the optic nerves, similar to the retro-bulbar neuritis with which we are familiar as a consequence of the action of various other poisons.

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CHAPTER VIII

PLAGUE

Most of the writers on plague have drawn attention to a marked congestion of the conjunctivæ as a characteristic of the affection. Some of them describe the corneæ as bright and shining; this latter observation presumably refers to a very early period of the disease. Many more speak of a half-drunken, dazed look as the typical facies of established plague; at this stage, attention is invited in their writings to the sunken eyes and drawn features of the patient.

It is apparently to Cantlie that we owe our first description of the really serious eye changes associated with this disease; the reference is contained in his statement, that in a comparatively small number of cases "sight becomes affected by intra-ocular changes, probably located in the choroid." The value and correctness of this observation will be best appreciated when we come to speak of Youdine's work on the pathology of the eye-changes of plague.

Maynard's experience of the disease (1901) appears to be of sufficient interest to warrant his article being quoted at some length:

"During the recent severe epidemic of plague in Patna, I came across 12 cases in which there were ophthalmic complications. The notes are briefly recorded below. In all, the attacks were severe; 7 had buboes that suppurated; and in the majority there was delirium or insensibility. The lesions met with were not, however, the result of lagophthalmus. They were rather the results of iritis and opacity of media, apparently from interference with the nutrition of the eye.

"Of the 12 patients examined, 6 recovered with one eye sound. In the remaining 18 eyes, the following lesions were noted: Cornea—hazy in 4, opaque in 2, and sloughed in 4. Iris—signs of iritis, varying from a few dots of pigment on the anterior capsule to occlusio pupillæ, in 12 cases, and in 3 others the iris was prolapsed. Sclera—scleral staphyloma was met with twice. In both cases it was ciliary, and in each the dark projection was separated from the corneal margin by a strip of healthy-looking sclera. In 1 the iris was evidently drawn up into the staphyloma, and its upper portion was not visible through the clear cornea. Lens—was hazy in 7 eyes and quite opaque in 5. The media were hazy in 6. The fundus was normal in 3, showed a hæmorrhage in 1, and the appearance of a limited retinitis pigmentosa in 1 other. The tension was diminished in 12 cases, normal in the rest. Vision—Nil in 5, p.l. only in 8, and fairly good in 5.

"The enumeration of these lesions shows the serious nature of the eye complications of plague when they occur. The most remarkable feature in plague post-mortem examinations is the extensive extravasations of blood that are met with throughout the body. I was prepared and on the look-out for similar hæmorrhages in the eye. In only one eye was one found. The media are so hazy usually, however, that more examinations of the fundus in various stages of the disease are required, before dismissing this as a possible explanation of the destructive changes met with. The rapid development of scleral ectasiæ and the usual diminution of tension are rather remarkable. Scleral ectasiæ usually develop slowly, and oftenest from increased tension. In these eyes the sclerotic must have become less resistant to normal or even reduced pressure.

"Treatment was of no avail, because started too late perhaps, in all except one case, where potassium iodide and nux vomica internally, atropin and blisters on the temples, seemed to have a good effect. The tension rose to normal and the sight improved. It was the good result after treatment in this case that caused several of the others to consult me."

In giving prominence to these very interesting observations, a doubt may be expressed as to the possibility of excluding exposure of the globe as a factor in the corneal complications. The plague patient in the East lies for a comparatively long period with his half-closed eyes exposed to dust, hot air, and the assaults of insects. Too often the protection of the globes is totally neglected by his friends. The consequences may easily be imagined. It is interesting to remark that in at least two of Maynard's cases it was the lower part of the cornea that was attacked; this reminds us of the fact that the same observation is only too often on record in smallpox and other illnesses in which, in Eastern countries, the eyes are neglected whilst the patient lies in a comatose condition. It is also very significant that the complications were met with only in severe cases, in which mischievous exposure of the eyes would be very likely to have occurred.

In 1906, P. Rees recorded the case of a Chinese woman with occlusive iritis and hypopyon in the left eye and irido-cyclitis in the right eye, and remarked that, though marked and evanescent eye symptoms are seen in plague, they are unusual. He further characterised the appearance of iritis and irido-cyclitis in this disease as rare. His case recovered with the aid of atropin.

Inoculation.—The rôle of the rat and the flea in spreading plague is now well known. At the same time, it is an accepted fact that the *Bacillus pestis* can be directly conveyed to man. From the ophthalmologist's point of view this adds an interest to Cantlie's observation, that a nurse died in Hongkong of plague, as a result of receiving on her conjunctiva the sputum of a patient suffering from the disease. Even before this, Yamagiwa had described conjunctivitis as a complication of the disease, and Calmette and Salambeni had found the *Bacillus pestis* in the conjunctival pustules of their patients. Nor has the evidence from experimentation been wanting, since Römer was successful in producing an attack of plague by the instillation of cultures of the organism into the conjunctival sac of an animal.

Pathology.—A very valuable addition to the ophthalmic literature of the subject has been recently supplied by Youdine, who examined 19 eyes of 15 patients who had died of plague ; 16 of these were enucleated two or three hours after death. The lesions discovered were mainly localised in the posterior segment of the chorio-retina. He came to the conclusion that when irido-cyclitis, serous iritis, and non-suppurative kerato-iritis are present, they are due to the propagation forward of the inflammation which had begun in the posterior part of the uveal tract. The following changes were observed : The veins and capillaries of the choroid were widely dilated, and especially so in the neighbourhood of the optic disc. In some of the eyes the dilated vessels were seen, in section, filling up almost the entire thickness of the choroid. Their walls were thin and the endothelium was swollen. In some instances the coat was necrotic. In one case, which lasted 34 days, there was hyaline degeneration of the walls of the small vessels. The layers of the choroid and the space between the choroid and retina were filled with inflammatory exudate. The retinal vessels were gorged with blood, and the perivascular spaces were dilated. The endothelial nuclei were so much swollen that they projected into the lumens of the vessels. The ganglion cells were slightly pigmented ; the cells of the granular layers were swollen, and showed a lack of chromatin. There was cystoid degeneration in the internal nuclear layer. In all cases the retina was more or less detached from the choroid by exudate. No bacilli could be found in the eyes, thus leading to the conclusion that the ocular lesions were due to circulating toxins.

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CHAPTER IX

SMALLPOX

This disease is of interest to practitioners in the Tropics by virtue of three factors—(1) Its wide prevalence, (2) its great severity, and (3) the neglect often shown to patients suffering from it. It is a common sight in the out-patient room of a large hospital in the East, or in any other public place, such, for example, as a railway station or a bazaar, to see children covered with smallpox rash in the arms of their mothers, or running about among their companions. Little or no effort is made to stop this kind of thing. Very much has been done by Government agencies, in lands under British rule, to get the people vaccinated, and these efforts are not unappreciated, but a large portion of the population still remain unvaccinated. If this latter statement is true for India, how very much truer is it for the less progressive lands under Eastern potentates, and for other still more backward parts of the Tropics. The type of smallpox seen amongst native populations is often a very severe one, and, owing to a mixture of poverty, apathy, and ignorance, the semi-unconscious victims of the disease are often very gravely neglected by their friends and relatives. During the stage of high fever, they often lie for long periods on or near the floor with their eyes only half-closed, and exposed through the open lids to the injurious influences of dry, hot winds, of dust, and of injury from the accidental or deliberate assaults of insects.

The Eye Symptoms.—According to Osler and other writers, a conjunctivitis, either of a catarrhal or of a purulent type, is commonly met with in severe cases of the disease even in European countries ; the eyes are then apt

to be closed up, owing to the adhesion of the lids under the influence of dried secretion; unless this is prevented, a diffuse keratitis may be excited and may pass on to ulceration and perforation. Under these circumstances, inflammations of the iris and ciliary body are not very uncommon.

Apart from these forms of conjunctivitis, the variolous eruption is said to be not infrequently met with on the conjunctiva and on the lids. Owing to the looseness of the cellular tissue in the latter neighbourhood, considerable local œdema is usually present. The pustules on the lids are quite frequently found on the ciliary border, where they give rise to partial alopecia from destruction of the cilia; nor are the puncta lachrymalia safe from implication (Roche). Ectropion of the lower lids may sometimes result from the extensive cicatrisation, which is apt to follow in confluent attacks of the disease (Sabongy).

When the eruption occurs on the conjunctiva it causes great pain and very considerable congestion of the eye. Owing to the moist condition of the parts, ulceration supervenes at an early date. The cornea may become directly involved by the spread of such ulcers, especially when the latter commence on or close to the limbus, but it is never itself the primary seat of a pustule. Most writers lay predominant stress on the important rôle of the smallpox eruption in the production of blindness. There can indeed be no question that this disease is responsible for a heavy item in the bill of blindness in any tropical country. Thus according to Bruch, 1 case in every 4 of blindness in Algeria is due to this disease; most certainly in India smallpox is answerable for a very large number of cases in which sight has been lost. While admitting all this, the author is very strongly of opinion that the real cause of blindness in most cases is to be sought, not in the ravages of the eruption, but in the factor which has been pointed out above, namely, the neglect of the patient's eyes in the critical pyrexial periods of the disease. If any surgeon will take the trouble to inquire into the history of every case he sees in a tropical out-patient room, with

extensive and very dense leucoma of the lower part of the cornea, he will find that a large percentage of the patients will date their blindness back to an attack of smallpox. As has already been pointed out, the upturned eye of the semi-conscious sufferer is exposed, owing to the half-closure of the lids, to the long continuance of conditions which are prone to lead to severe keratitis, and even to ulceration, perforation, irido-cyclitis, and panophthalmitis. On the other hand, if the lids are left stuck together, the locked-up purulent secretions are scarcely less potent for harm.

Treatment.—The most important element in this is *prophylaxis*. The eyes of all smallpox patients should be most carefully looked after. The lids should be gently but thoroughly cleansed, and the eyes irrigated, if necessary, with warm, normal saline solution. Where any form of conjunctivitis or keratitis is present, a solution of argyrol (12½ per cent.) should be freely instilled every few hours during the waking period. The edges of the lids should be prevented from becoming stuck together by smearing them with yellow[1] vaseline. Atropin should be used to relieve pain, especially if keratitis, iritis, or irido-cyclitis is present. Should the patient not be seen until a late period, and at a time when the cornea threatens to perforate peripherally, the use of atropin is obviously contraindicated, for it may provoke or increase a prolapse of the iris. Such ulcers must be treated on ordinary lines; under the circumstances, their presence constitutes a very serious situation.

The **late complications** must be treated in the usual manner. Streiff has advocated an ingenious method of hiding the leucoma which is often so disfiguring in these cases. He tattooed the centre of the cornea with Chinese ink to represent the pupil, and imitated the iris, by tattooing separately with the ink and with gold dust; he moistened the latter with a 1 in 1000 solution of mercuric chloride, and applied the ink after the removal of the epithelium.

[1] Yellow vaseline is preferable to white, since it is free from the chemicals used in bleaching the latter.

Three or four sittings were required, and a year later the result appeared very satisfactory.

In tropical countries, where the people are innocent of the crudest ideas of hygiene, and where conjunctivitis is rife, careless people are apt to infect the lid edges and the conjunctiva by handling vaccination pustules, and then rubbing or scratching their eyes with their fingers. The condition presented may be that of multiple vaccination, and may be both alarming and puzzling.

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CHAPTER X

TRYPANOSOMIASIS

LAVERAN, in his classic work on trypanosomiasis, called attention to the puffiness of the face and the œdema of the eyelids, which are often present in the early stages of the disease, and which are to be interpreted as evidences of local œdema and erythema. He stated that the pupils are equal, and usually dilated, and that there are no ocular paralyses or changes in the fundus oculi. In the second stage (the so-called sleeping-sickness) the eyelids are closed owing to drowsiness. He makes no reference to eye complications, and does not appear to have observed them. With regard to experiments on animals, he mentions the false membranes which form in the anterior chamber of the eye in infected dogs, and states that these may lead to the loss of sight in one or both eyes. In rabbits he found the disease to run a protracted course, and in these animals he observed double blepharo-conjunctivitis with discharge of muco-pus. Thomas and Linton also noticed these symptoms, which appear to be common to the different forms of trypanosomiasis in rabbits. Laveran advocated the use of atoxyl, and knew of no evidence that it led to optic atrophy.

In 1911, Daniels recorded the production of a recurring keratitis in a dog six months after experimental infection with Rhodesian trypanosomiasis. Successive recurrences of interstitial keratitis were cured on each occasion by injections of arseno-phenyl-glycin. He observed that keratitis had been similarly produced in lower animals as a result of trypanosome infection, especially with the Rhodesian strain.

Darling investigated a newly discovered trypanosome disease (Murrina), met with in horses and mules, and due to *T. hippicum*; he found conjunctival ecchymoses and conjunctivitis present.

Stephens and Fantham found that *T. rhodesiense* produced keratitis in dogs, while *T. gambiense* failed to do so.

Kerr had under treatment a lady, aged 45, who had contracted trypanosomiasis in Portuguese Loanda. She developed a right-sided irido-cyclitis, followed by a severe conjunctivitis, which showed a tendency to recur.

For the most important contributions to the literature of this subject we are indebted to Daniels, who lays great stress on the importance of recognising the disease at the earliest possible stage, since the probability of recovery is greatly increased thereby. In a patient coming from tropical Africa, eye lesions, which may possibly be due to trypanosomiasis, should lead at once to a very careful examination of the blood. These lesions "are often painful and always noticeable, and in practice have been the first signs that caused some of the patients to consult a medical man." They are the more important since they may appear at a time when other signs of the disease, even if present, have not attracted attention. Daniels gives the following list of the grounds for suspecting a case to be one of trypanosomiasis—(1) Continued pyrexia, which does not yield to quinine; (2) enlarged glands, usually cervical; (3) an erythematous circinate rash, sometimes described by the patient as bruises, usually occurring on a covered part of the body and causing no irritation; (4) ocular symptoms (often absent throughout); (5) orchitis (often absent throughout); (6) delayed pain after deep muscular bruising, a very variable symptom; and (7) cardiac irritability and weakness. He lays most stress on (2), (3), and (4), and insists on the necessity of verifying the diagnosis by discovering trypanosomes in the blood.

The Eye Lesions in Animals.—The eye lesions met with in man are similar to those which have been described in dogs, but are of a milder type. For this reason, and also because the opportunities of animal experimentation have been

greater than those afforded for the observation of human cases, it is advisable to review the former first. This is the easier since de Schweinitz and Woods have recently contributed a very valuable experimental study on the subject, using *T. equiperdum* for the purpose. The time elapsing before eye symptoms made their appearance varied from 2 to 18 days after the discovery of trypanosomes in the blood, the commonest period being from the 5th to the 12th day. Two distinct types were noted—(1) Simple clouding of the cornea; and (2) clouding of the cornea, accompanied by circumcorneal injection, photophobia, iritis, and hæmorrhage and exudations into the anterior chamber. The use of successive inoculations increased the virulence of the organisms and the severity of the iritis. In some of the dogs *iris bombé* was observed, followed by clouding of the cornea. The causative organisms were uniformly found in the aqueous, and the vitreous of a freshly enucleated globe showed actively motile trypanosomes. The hæmorrhages into the anterior chamber were attributed to thrombosis or rupture of the iris vessels by the parasites. There was nothing in the blood appearances to show why some dogs developed eye lesions and others escaped them. The cornea was found to be two or three times as thick as normal; the changes in it were limited to the substantia propria, which was loose and distended and contained polynuclear and mononuclear cells. Newformed capillaries spread from the sclera into the cornea. Trypanosomes were abundantly demonstrated between the corneal lamellæ; they stained well with alum-iron-hæmatoxylin and also with the Romanowsky (Wright) stain, but not so well with other stains which were tried. The iris stroma showed areas of distension, which contained granular material, fibrin, small round cells and polynuclear cells, but no trypanosomes. There was a thin layer of exudate over the iris and ciliary processes. In the latter a few trypanosomes could be seen. Small focal lesions were present in the retina, and were manifested by slight thickening, looseness of structure, indistinctness of the ganglion cells, fulness of the capillaries, and general

mononuclear infiltration of the deeper layers. Over the surface of these foci was a homogeneous material, including degenerate trypanosomes. Arseno-benzol was injected in 4 dogs and the eye lesions rapidly cleared up, but one injection of the drug was not sufficient to effect a permanent cure of the disease.

The experimental lesions in animals, caused by the trypanosome, are very similar to those set up in man by the spirochæta pallida ; in both there is an actual invasion of the tissues by the parasites. De Schweinitz and Woods are convinced that the cause of the eye troubles is this invasion. The organisms, living in the tissues, elaborate their toxins there. Thus a satisfactory explanation is furnished of the symptoms which are known to be present. In writing the above, the author has been greatly helped by Stephenson's admirable abstract of the American article in the *British Journal of Ophthalmology*, vol. i. p. 774.

The Eye Lesions in Man.—The following have been described—(1) An irido-cyclitis of a mild type, never associated with hæmorrhage into the anterior chamber, such as occurs in dogs ; (2) an unusual form of choroiditis ; (3) a mild diffuse interstitial keratitis ; (4) rarely, a muco-purulent conjunctivitis ; and (5) a marked œdema of the lower eyelids, giving rise to a puffiness of the face, which is not associated with any evidence of cardiac or renal disease, and which may easily be mistaken for the similar appearance met with in *Filaria loa* infections.

The *irido-cyclitis* and the *keratitis* are sometimes associated with a ring of circumcorneal congestion with photophobia, and with pain and aching of the eye ; but, as already intimated, their usual leading characteristic is that they are not severe affections. The brunt of the attack of trypanosomiasis on the eye undoubtedly falls upon the anterior segment of the organ, but there is one case on record of an unusual form of *choroiditis* which was examined and described by Treacher Collins. In the macular region of each eye there was an area of superficial choroidal atrophy, with some pigmentary disturbance ; in the right eye this area was irregularly star-shaped ;

whilst in the left the pigment disturbance was more marked, and formed denser spots than in the right. Outside the patch of atrophy in the right macular region, were some small, regularly circular, discrete, whitish dots, situated at a level deep to the retinal vessels. In the periphery of each fundus were several small, light-coloured disseminated patches, apparently due to choroidal atrophy. Some of these had a slight amount of pigmentary disturbance around them. Apart from the appearances described, the fundi were normal.

A *muco-purulent conjunctivitis*, though apparently comparatively rare in human subjects, is much more commonly encountered in animals, who have been experimentally infected with trypanosomes.

It is noteworthy that we have so far had no record, in man, either of hæmorrhages into the anterior chamber or of retinitis ; but the fact that both these conditions have been met with in animals should warn the physician, practising in the Tropics, to be on the look-out for their appearance in his cases of trypanosomiasis.

" It is difficult to state how long after infection the eye lesions manifest themselves. In some cases they have been the first definite sign noted, but the other signs may have been overlooked by the patients and by the medical attendants ; there is proof of this in some cases. The onset of eye lesions in 2 cases was definite 3 months after infection ; in 2, 4 months ; and in one remarkable case, the eye had been removed for neglected irido-cyclitis before the discovery of the trypanosomes. Sixteen years later, the lady developed a severe irido-cyclitis in the remaining eye, which had given her slight trouble from time to time in the interval. The extraordinary feature of the case is that she had been living for many years in Canada far from any possible source of reinfection " (Daniels).

It would appear that ocular complications are most frequently met with in the Rhodesian cases, less so in the Nigerian, and least of all in those from Uganda and the Congo. With regard to the Nigerian cases, there would seem to be a doubt whether the infecting organism is

T. gambiense, or that described as *T. nigeriense*. In the Uganda and Congo patients, the former of these organisms is responsible for the infection, whilst in the Rhodesian cases, *T. rhodesiense* is to blame. The following table by Daniels gives his latest figures on the subject :

Variety.	Cases.	Deaths.	Eye Lesions.
Rhodesian .	8	7	6 (75 per cent.)
Nigerian . .	16	3	6 (37 „)
Uganda and Congo	18	3	3 (16 „)
Total .	42	13	15 (35·7 per cent.)

Treatment.—The symptomatic treatment of the various conditions above described should be conducted on ordinary classical lines. For the deep-seated inflammations of the anterior segment of the eye, the indications are to use atropin and dionin, to apply fomentations, and to protect the organ from light. The conjunctivitis, when present, should be treated with argyrol or collosol silver, the secretion being washed out from time to time. The main and obvious indication, however, is to kill off the organism that is causing the trouble. Koch advocated the use of atoxyl. Daniels has had good results from soamin (gr. 2·50). There can be no doubt that the eye symptoms yield readily to treatment by arsenic in one of these forms ; nor can there be any question that so desperate a disease both demands and justifies the taking of certain risks in its treatment. On the other hand, there is reason to believe that the over-use, and even the use, of these drugs has, in a number of cases, led to the loss of sight as a result of optic atrophy. The practitioner thus finds himself on the horns of a dilemma. On the first warning of optic nerve complications, the use of arsenical preparations should be stopped and the intravenous administration of tartar emetic solutions adopted instead. The dose of the latter drug advised is gr. $\frac{1}{2}$ gradually increased to gr. $1\frac{1}{2}$ in 6 oz. of normal saline solution (Manson).

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CHAPTER XI

TYPHUS

For almost the whole of our knowledge of the eye-symptoms of typhus, we are indebted to A. Dantrelle, who made full use of the opportunities, which presented themselves during the great epidemic in Roumania (1917).

He insisted on the importance, from a diagnostic point of view, of recognising the early and slighter ocular signs of the disease, and laid emphasis on the great service which such observations may render to us in times of epidemic typhus.

The Slighter Symptoms.—These are first dealt with and are taken in the usual order of their appearance.

1. **Hyperæmia of the Conjunctiva.**—This comes on with the fever; it is often intense, and sometimes lasts throughout the febrile period. During an epidemic of typhus, a number of cases of acute conjunctivitis may be seen, which, in reality, are a manifestation of the disease. A careful look-out should be kept for them, and the patients should be watched.

2. **Sub-conjunctival Ecchymoses.**—These are of frequent occurrence; they vary in size from that of a pin's head to that of a lentil, and each is situate on the course of a visible sub-conjunctival vessel. They are most commonly found either in the lower cul-de-sac, or on the bulbar conjunctiva, in the palpebral slit, and close to the limbus. In the latter situation they have been given the very inappropriate name of "vascular pterygia." The conjunctival ecchymoses appear at the same stage of the disease as those on the skin; they may last a long time, even for months.

3. **Ciliary Alopecia.**—This is an infrequent symptom; the lashes may drop out in large numbers.

4. **Meiosis.**—This is an inconstant, but sometimes highly marked sign; the pupils may be pin-point, and may fail to react to light. The cause is a spasm of the iris, which is accompanied by photophobia; it occurs in the "bulbar" forms of the disease, and is of evil prognosis.

5. **Photophobia** is frequent, even apart from meiosis; the patients hide under their bedclothes to avoid the light. Certain colours, especially red, prove very irritating. During the pyrexia, some of these patients complain of seeing "through a fog." The photophobia is most marked in the bulbar forms, and is an evidence of the participation of the brain in the infective process.

6, **Fundus Changes.**—The optic disc often shows a slight hyperæmia, with haziness of the papillary edge; but recovery is complete.

7. **Mydriasis** sometimes comes on as the temperature falls; it is accompanied by loss of the light reflex, and may last a very long time.

8. **Nyctalopia** sometimes occurs, but only in a slight form.

The more alarming signs are next dealt with; they occur in about 1 per cent. of all cases, and are divided by Dantrelle into two categories—(1) Those of the febrile period, which are due to the action of the still unknown germ of the disease; and (2) those of convalescence, in which superadded infections play a part.

The Complications of the Febrile Period.—These are of vascular origin, and are usually discovered at the end of the first week, or at the beginning of the second; but it is to be borne in mind that the patient's condition conceals the real time of their onset. They consist of three forms of lesions.

1. **Iris Changes,** associated with secondary cataract. There is a discoloration of the iris, but no formation of posterior synechiæ. The cataracts develop very rapidly, and are complete in from one to two months; they begin about the tenth to the fifteenth day of the disease. They

often occur in young subjects, and are consequently of the soft variety. The fundus shows no change, and the results of operation are favourable; but after extraction, a sub-conjunctival ecchymosis sometimes appears on the fourth day, even though many months may have elapsed since recovery from the disease. The condition may be unilateral or bilateral, more frequently the former.

2. **Alterations of the Fundus.**—These may be of two kinds—(*a*) A curious *condition of perivascular change*, characterised by the appearance of pigmentation along the retinal vessels. These pigmentary trails ensheath the arterial or venous branches, and thus form a dark network superimposed upon the normal design of the vessels. This network may be fine or coarse; it is cicatricial in character, and is indelible, being associated with destruction of the functions of the corresponding part of the retina. (*b*) *Optic neuritis*, leading at a later stage to optic atrophy. The intensity of the inflammation and the degree of the atrophy vary considerably; some at least of the cases are double, and end in complete blindness.

3. **Ocular Paralyses.**—These appear in the febrile period; they have been observed to attack the third and sixth nerves; one case was associated with unilateral optic atrophy. It is believed that they are due to an attack by the typhus organisms on the nerve centres, or else to some old-standing focus of sepsis being stirred into activity as a result of the disease.

The Complications of Convalescence.—These are of a different nature from the preceding, and are relatively much more common. They usually appear in the first week after the fever has come to an end. Streptococci are always found in pure cultures at the seat of the lesions. The following have been observed:—

1. **Palpebral Abscesses.**—These are frequent, and usually harmless; as a rule, at least two abscesses are present; they either commence spontaneously on the third or fourth day of apyrexia, or else follow an attack of erysipelas. They are rapidly cured by incision, and leave a hard pigmented fibrous scar. Rarely they produce lagophthalmus, but

never ectropion or entropion. The scars are so characteristic that a retrospective diagnosis of a former attack of typhus may sometimes be made from their presence.

2. **Orbital Phlegmon.**—This is a much graver complication, which appears from the seventh to the tenth day of convalescence, and entails a risk of consecutive optic atrophy. The abscess is usually situated above and to the inner side, leading to an exophthalmus in a downward and outward direction. It is almost always associated with multiple palpebral abscesses.

3. **Corneal Ulcers.**—These are very important, owing to their number, their evolution, and their therapy. They come on in the first week of convalescence, are severe in character, are very painful, and are often accompanied by conjunctivitis and iritis. They are situate at the lower part of the cornea, and rapidly become very deep ; they spread over a large area, often as much as two-thirds of the membrane. The infiltration extends far beyond the margin of the ulcer ; the latter spreads rapidly, both in area and depth. Perforation may occur with prolapse of the iris and atrophy of the eye. Sight is often lost, since the whole cornea becomes leucomatous ; indeed, this is the normal course of the typhus ulcer when unmodified by treatment. There is a striking resemblance between these ulcers and those observed in children suffering from measles in hospital.

4. **Optic Atrophy.**—This may be seen as a result of septic complications, such as erysipelas and phlegmon.

Treatment.—The course of the ocular complications is profoundly influenced by the general treatment of the disease, which should be conducted on ordinary lines. Abscesses should be opened early and freely. Great stress is laid on the employment of preventive measures during convalescence. It is recommended that the conjunctiva should be carefully disinfected by the frequent use of weak antiseptic drops and ointments. Anti-streptococcic therapy is very important, not only in the case of abscesses and phlegmon, but also in that of corneal ulcers. The last-named resist all ordinary treatment, but magnificent results are claimed from a combination of the subcutaneous daily

injections of 100 cc. of anti-streptococcic serum for several days in succession, with the free instillation of the serum into the conjunctival sac. Atropin is also of considerable value.

In cases of recent optic neuritis, the use of strychnine, combined with daily galvanisation, is said to give happy results. Once optic atrophy has been established, treatment is of little avail.

Operation for post-typhic cataract presents no special difficulty.

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The author is largely indebted to Dantrelle's article for the above references.

CHAPTER XII

YAWS

(Kindly Contributed by Dr. Louis W. Sambon.)

The eruptive elements of yaws are seen as frequently round the eyes as round the mouth, nostrils, anus and genitals. Certain authors say: "The Mucosæ, the eye and other sense-organs remain invariably immune" (Jeanselme); but that is not so. Yaws lesions, often similar in appearance to syphilitic leucoplakias, are seen on the tongue, the roof of the mouth, the soft palate, the larynx, the nasal mucosa, etc.

The eyebrows and eyelids are frequently the seats of yaws granulomata (Fig. 117). I have often seen small nodules on the eyebrow-line, and sometimes large agglomerations occupying the greater part of the eyebrow, together with the adjoining parts of the forehead and upper eyelid. Occasionally, the eyebrow patch may extend right across the bridge of the nose to the inner part of the other eyebrow. I have twice seen the granulomata on the palpebral border of the eyelid; one of the cases, seen in Jamaica, is described in my note-book thus:—"R. B. (Chester Castle, Parish of Hanover) — great, thick, sulphur-yellow, waxy crusts over both eyebrows; cluster on left side occupied inner part of eyebrow, covers upper eyelid and extends beyond border of lid to palpebral conjunctiva; bulbar conjunctiva injected, photophobia, lachrymation . . . small flies (*Hippelates*, sp. ?) walk over yaws lesions, crowd round the eyes and follow patient." In the other case, the palpebral border was the seat of the granuloma; the greater part of the inner margin of the upper lid being

covered with a thick brownish-yellow crust in which the eyelashes were matted. I cannot say what happens to the hair of the eyebrows or to the eyelashes when involved in yaws lesions, but I have seen on the eyebrows of young

Fig. 117.—Yaws. Notice the eruption on the eyelids. (Photo kindly supplied by Dr. Louis W. Sambon.)

children hairless patches which may have been due to yaws. One case, a Trinidad boy with hairless patches on left eyebrow and no alopecia of the scalp, had recently suffered from yaws. Castellani and Chalmers mention two cases of iritis of moderate severity which they ascribe to yaws; both patients presented "photophobia, ciliary

congestion, and discoloration of the iris." Breda has seen yaws granulomata on the palpebral margins, and has supplied a picture of the affected eyes. Breda, moreover, mentions inflammation of the lachrymal sac followed by fistula. Periostitis of the orbital margins has been noticed in yaws, and the margins are said to become thickened and painful to pressure.

Treatment.—Salvarsan injections rapidly cure yaws. Manson states that neo-salvarsan is even better in its curative effects. (Author's note.)

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CHAPTER XIII

VARIOUS GENERAL DISEASES

THERE are a number of general diseases in which eye symptoms are met with, and which therefore deserve a mention, in spite of the fact that the sum-total of our knowledge about each of them is comparatively limited. It has been thought well to deal with such in a single chapter. We shall take them in turn.

BLACK-WATER FEVER

Coincidentally with the appearance of the dark coloration of the urine, or even before this has been noticed, the skin and the whites of the eyes acquire a tint which is differently described by different observers ; some speak of it as a deep saffron yellow, others as a bright orange. In European patients this remarkable change in the colour of the skin is a very striking feature, which is to a great extent lacking in dark-skinned natives ; in the latter, therefore, the discoloration of the whites of the eyes is relatively more noticeable, and has therefore a corresponding importance in diagnosis. The icteric tinge persists, and may even deepen during the progress of the fever ; it passes away with remarkable rapidity as the urine and skin clear, and is merely an evidence of the extensive blood changes which are taking place in the body. McGregor has described a case, in which the bright orange colour of the eyes almost disappeared when the temperature fell, and reappeared again after each fresh rise, the condition actually changing from day to day. He states that the staining of the conjunctivæ preceded the coloration of the urine, and was

coincident with a like change of tint in the skin and in the tongue-fur.

Spectroscopic examination of the urine is reported to give the characteristic bands of hæmoglobin, and sometimes those of methæmoglobin. With the hæmoglobin there is also an escape of the serum globulin of the blood. Blood corpuscles may be entirely absent, or may be very few in number (Manson).

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DENGUE

Amongst the most striking signs of this disease are to be ranked severe headache, acute pain in the eyes, and marked photophobia. The face is red and puffy, and the eyes are brilliant and congested, leading, at first sight, to a suspicion of yellow fever, in countries where that disease is prevalent; the absence of jaundice as the condition progresses clears up the doubt. The bright red of the rash affects the skin of the eyelids as well as that of the rest of the face. All these parts share in the intense itching which is a feature of dengue. The patients are said to complain often of visual disturbances. The lessened acuteness of sight has been attributed to paresis of accommodation, as a result of general weakness. Red and yellow vision have also been noticed. Movements of the eyes give rise to great pain; it is, however, to be remembered that articular and muscular pains are experienced in this disease in all parts of the body. Many other complications have been ascribed to dengue; these include keratitis, iritis, irido-choroiditis, amaurosis, and muscular paralyses. Barkan has recorded one case of partial abducens paralysis, which caused diplopia on the 9th day, and cleared up in a few weeks. In a second case he observed paralysis of accommodation within 2 weeks of the commencement of the

attack ; this had wholly passed away within 6 weeks. He thinks that these temporary paralyses are sometimes overlooked in the ignorant tropical populations, who are chiefly subject to this disease.

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DIABETES

This disease is extraordinarily common in the East, and it is therefore important to test the urine for sugar in every case before any major operation is undertaken. On the other hand, there is a tendency, in Europe at least, to make too much of the dangers of cataract extraction and other similar procedures in the diabetic. Provided that the patient is in a good state of general health, and is not losing weight, the presence of sugar in the urine is not a contra-indication to the performance of an operation, always provided that di-acetic acid and acetone are absent. The wound heals well, and convalescence does not appear to be interfered with. It is an obvious indication to make a careful examination beforehand, and to attend to the diet, and to the general regimen, on such lines as will ensure the patient being in as favourable a condition as possible for the ordeal before him. Noble has laid down that operation should be postponed when more than 2 per cent. of sugar is present in a total of 3 pints or more of urine daily. He and Doyne have each published a case in which a major operation was followed by coma and death. There is a commonly accepted belief that the diabetic are especially predisposed to the occurrence of cataract, and that it matures very rapidly in them. The existence of a type of diabetic retinitis is also almost an article of faith, in spite of the fact that many of these cases have albumen as well as sugar in the urine.

These matters deserve the critical attention of surgeons practising in the Tropics.

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ENTERIC FEVER

Cycloplegia is sometimes, though rarely, met with after enteric fever. A complete recovery is usually to be expected, though it may be delayed for weeks or months; there is one case on record of permanent paralysis of accommodation following this disease (Stephenson). Carpenter has met with cases of definite optic papillitis, of a type which is not uncommon in tubercular meningitis, but apart from any evidence of meningitis. He believes the neuritis to be a result of the local action of the typhoid toxins. The author saw a young officer suffering from an acute central choroiditis, which resulted in total loss of central vision of the eye affected, and which followed an anti-typhoid injection; there seemed to be little doubt that it was a case of cause and effect.

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HEAT-STROKE

Manson has pointed out that under this term at least three different conditions have been included—(1) Heat-exhaustion, or the fainting, which may follow prolonged exposure to a high atmospheric temperature; (2) siriasis,

an acute disease, developing in the presence of high atmospheric temperature, and characterised by the sudden incidence of hyperexia, coma, and extreme pulmonary congestion; (3) sun-traumatism, which includes a large number of heat-stroke cases, many of which cannot be satisfactorily defined.

We are concerned mainly with the last two of these classes, for all that has to be said of heat-exhaustion is that in it the pupils are dilated. In siriasis, intolerance of light is a very prominent symptom, and together with the accompanying headache may be the main source of the patient's complaints. Chromatic aberrations of vision are also common, and the eyes are seen to be suffused. Manson quotes from Wood as follows:—"The conjunctiva is often injected, the pupils various—sometimes dilated, sometimes nearly normal, sometimes contracted." He adds: "The pupils, unless immediately before death, when along with the sphincters they relax, are contracted. The reflexes are partially or wholly in abeyance." He states that "cerebro-spinal fever, so often mistaken for siriasis, may be recognised by the occipital retraction, the irregular pupils, and the frequent occurrence of strabismus."

Of sun-traumatism little remains to be said, as we have already discussed the subject in dealing with the effects of the exposure of the eyes to strong lights in tropical countries (*vide* Section II.). The author would insist on the importance of recognising that the popular idea in the East, that a patient may get a sunstroke through the eyes, is no myth. The dreadful intolerance of light experienced by patients suffering from sun-traumatism has only to be experienced, in order to be remembered for the rest of a lifetime. It is associated with a similar dread of the slightest sound, or of any movement, and is strongly suggestive of meningeal congestion or worse. As the patient recovers, all his acute symptoms pass away, but he may be left with a long-standing, or even with a permanent intolerance of light, which makes his whole service in the East a long-drawn misery. As has above been pointed out, the reader will find this subject dealt with at much greater length in

Section II. The treatment has also been fully discussed there.

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SAND-FLY FEVER

In the *Journal of Tropical Medicine*, 1914, on p. 251, Colonel Birt, A.M.S., laid stress on the conjunctival injection and post-ocular pain of this disease. The author can confirm these observations from an experience of sand-fly fever in Madras ; the pain in the eyes and the accompanying headache were excruciating, and in his own case were only relieved by morphia ; the injection of the eyes was well marked. The pain is probably of central origin.

THE TROPICAL RELAPSING FEVERS

For the purposes of this work it may be assumed that the group of tropical fevers, which have been variously described as "relapsing fever," "recurrent fever," "recurrent typhus," "African tick fever," etc., are practically identical, and are caused by spirochætes, closely allied to the *Spirillum obermeieri*.

Osler has stated that ophthalmia is not only met with in some of the epidemics of relapsing fever, but also that it may prove a tedious and serious complication. Castellani and Chalmers have noted œdema of the eyelids as a symptom of the relapses in tropical cases ; they add that iritis is very frequently observed in this disease. Drake-Brockman had under his care 10 severe cases of African tick fever ; 4 of these suffered from irido-cyclitis ; in 3 of them this complication was confined to one eye, while in the 4th the affection was bilateral. The ultimate results appear to have been favourable.

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UNDULANT FEVER

A. Garrow (*Journ. Trop. Med.*, 1911, p. 242) has called attention to an icteric tinge of the skin, and of the conjunctivæ, in hepatic cases of this disease. The liver is markedly enlarged, and the yellow colour of the whites of the eyes is very noticeable. The staining is obviously due to changes in the blood.

YELLOW FEVER

Very early in the disease, and sometimes as soon as the first day, there is marked hyperæmia of the face and eyes. The former is flushed, the latter are bright red, watery and brilliant. Indeed the "ferrety eyes" of this condition have acquired a well-known diagnostic significance. The eyelids are slightly swollen. Photophobia is a marked symptom. As a period of remission approaches, the red colour fades, and shortly afterwards the deep yellow tint, characteristic of the disease, is observed. It is stated that in severe cases, the conjunctiva may remain for a long time red, and that in still other cases, the icteric tinge is to be seen from the first, and even before the subsidence of the congestion. At a late stage, and in severe cases, subconjunctival effusions of blood may be observed, or actual hæmorrhage may occur and give rise to a steady sanguineous flow from the palpebral apertures.

Conjunctivitis, ulcerative keratitis, and even panophthalmitis have been ranked amongst the late eye manifestations of yellow fever.

The fixed, intense, and persistent headache of this disease is largely referred by the patient to the eyeballs.

Amblyopia and amaurosis are said to occur in the absence of any appreciable ophthalmoscopic signs, and they have therefore been attributed to toxæmia. This view has been supported by the association of these symptoms with suppression of urine and with violent delirium.

Santos Fernandez speaks of dilation of the pupils being so marked as to give the yellow-fever patient a vague and undefined expression, suggestive of alcoholic intoxication.

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INDEX OF SUBJECTS

Abrus precatorius, 127.
Absorption of rays of spectrum, 35.
Acarina, 138.
Accommodation, early failure in Indians, 394.
Acuity of vision in beriberi, 410, 413.
  in cholera, 417.
  in dengue, 501.
  in savages, 383, 384.
Æsculin monoxide, 47.
African tick fever, 505.
After-cataract, 283.
After-images in solar retinitis, 70.
Alopecia, 493, 498.
Amblyopia in beriberi, 407.
Anæsthesia, local, for removal of insects and parasites, 137, 138, 180, 194, 195, 198.
Animal life, tropical abundance of, 117, 119.
Ankylostomiasis, 183–186.
  cataract in, 184.
  fundus changes in, 184.
  signs and symptoms of, 183.
  statistics of, 186.
  toxins evolved in, 185.
  treatment of, 186.
Ankylostomum duodenale, 157, 183.
Anti-aircraft service, sun-blinding in, 66, 67.
Anti-enteric inoculation, 503.
Antimony, dangers of, 75.
Ants, 118, 122, 137.
Apathy of Eastern peoples, 368.
"Aqua Zeozoni," 48.
Aqueous chamber,
  couched cataract in, 229, 230.
  filaria in, 174.
  maggot in, 196, 197.
Arachnida, 119, 138.
Argentine, 153.
Argyrosis, 324.
Arsenic, dangers of, 75.
Arterial pulse,
  in ankylostomiasis, 184.
  in cholera, 417.
Arterio-sclerosis, 388.
Arthropoda, 119, 139, 187.
Ascaridæ, 157.
Ascaris poisoning, 131.
Aspergillosis, 208.
Assam tea gardens, 312.
Asthenopia, glare. *Vide* glare.
Astrologers, 10.
Atoxyl, 490.
Atrophy of retina and choroid, 391.
Atropism, 252.
Authority, lack of action by those in, 4.
Auto-intoxication, 15, 19, 447.
Aviators, sun-blinding in, 66.
Ayahs, 396.

Bandage, Madras cataract, 260.
Bats, 142.
Bees, 118, 133.
Bees' and wasps' stings, 118, 133–135.
  animal experiments with, 134.
  results of, 134.
  treatment of, 134.
Beetle larva, 196.
Beetles, 139, 142.
Benin, 162.
Beriberi, 405–415.
  a deficiency disease, 406.
  ætiology of, 405.
  dropsical, 407.
  endemic or epidemic, 405.
  eye symptoms of, 406–413.
  liability of pregnant women to, 406.
  mortality in, 405.
  ophthalmoscopic appearances in, 412.
  paraplegic, 407.
  pathology of, 413.
  prognosis in, 412.
  seasonal prevalence of, 406.
  sex preference in, 406.
  treatment of, 412, 413.
Bitot's syndrome, 76.
Bjerrum's method, 65.
Blackmail, 11, 397.
Blackwater fever, 500.
Blepharitis acaria, 145.
Blepharospasm, reflex, 43.

Blind painful eyeball, 373.
Blood coagulability, low, 385.
Blow-flies, 188.
Boils, tropical, 385.
Bot-flies, 188.
Bothriocephalus liguloides, 155.
Breeze, afternoon, 97.
Bung-eye, 136, 139.

Calabar swelling, 165.
Callousness of the people, 113.
Calumny of Western practice, 14, 368, 398.
Cantharis vesicatoria, 125, 139.
Capsule, laceration of, 265.
Capsule-laceration operation, 263.
  safety of, 264.
Carriages, protection of, from light, 46.
Caste, respect for, 402.
Cataract, 245–288.
  anterior polar, 134.
  belt, 284.
  black, 89, 248.
  causes of, 285, 286, 287, 288.
  due to lightning, 56.
  electric, 56.
  following stings, 134.
  frequency of, in Tropics, 285.
  hypermature, 16.
  immature, 248, 264.
  in ankylostomiasis, 184.
  in cholera, 417.
  in leprosy, 439.
  in retinitis pigmentosa, 390.
  intumescent, 372.
  juvenile, in pellagra, 474.
  maturity of, 246.
  Morgagnian, 247, 373.
  nuclear, 247.
  partial, 57, 60.
  pearly sectored, 247, 373.
  posterior cortical, 57.
  post-typhic, 493, 496.
  radially marked, 247.
  rules for beginners in India, 246.
  selection of cases for operation, 246, 250.
  statistics of, 286.
  teaching of operations for, 245.
  types easy of removal, 247.
Cataract couching. *Vide* couching.
Cataract extraction, 245–284.
    acute iritis after, 281.
    after management of patients, 261.
    after treatment, 280.
    arrangement of patient on table, 259.
    auto-intoxication in, 249, 282.
Cataract extraction by hospital staff, 398.
    complications before, 248, 353, 357, 359.
    degree of visual acuity before, 249.
    dressings, 280.
    fans, 259.
    field of projection, 249.
    injury after operation, 283.
    keratitis after, 282.
    leaking section after, 283.
    Madras bandage, 260.
    Madras operation, 265–275.
      complications in, 266, 268, 270.
      delivery in, 270.
      iridectomy in, 269.
      irrigation in, 272.
      laceration of capsule, 265, 272.
      section in, 267.
      toilet of wound in, 272.
    masks, 259.
    methods of, 263.
    panophthalmitis after, 281, 337, 338.
    perchloride irrigation, 252.
    post-operative conjunctivitis, 280.
    preparation of patient for, 251.
    prolapse of iris after, 282.
    results of in the East, 337.
    retained cortical masses, 282.
    rules for, 277.
    self-control of patient, 248.
    state of conjunctiva, 248, 282, 338.
    state of general health, 248.
    state of lachrymal passages, 248, 338.
    sterilisation of accessories, 254.
    sterilisation of conjunctiva, 252.
    sterilisation of instruments, 258.
    subacute iritis after, 282.
    surgeon's hands, 259.
    warnings, 276.
Caterpillars, 125, 139.
Causative organisms of disease, 149.
Cautery, actual, 14.
  ball and spindle-shaped, 356.
  native use of, 27.
Census of blind, 5.
Centipedes, 119, 120, 139.
Cestodes, 153.
Change of doctors, Eastern method, 27.
Charitable relief for patients, 6, 385, 401.
Chenopodium, oil of, 186.
Chigger, 145.

Cholera, 416-418.
cataract in, 417.
cyanosis of lids in, 416.
exposure of eyeballs in, 416.
lachrymal secretion in, 416.
lagophthalmus, 416.
ophthalmoscopic appearances, 417.
prognosis from pupillary reflex in, 417.
pupils in, 417.
retraction of eyeballs in, 417.
vision in, 417.
vitreous opacities in, 417.
Choroid, ischæmia in quinine poisoning, 466, 468.
rupture of, 58.
Choroidal vessels, 365.
Choroiditis, 392, 425, 440, 488.
Choroido-retinitis, central, 58.
Chrysops dimidiata, 161, 168.
excutiens, 174.
Chunam, 334.
Cinchonism, 464.
Clothing of patients, 400.
Cocaine, theft of, 401.
Coccus cacti, 125.
Cochineal insect, 125.
Coloboma, dazzling from, 370.
Colour vision, 67, 79, 410, 466.
Colubrine snakes, 143.
Coma, quinine, 467.
Comatose patients, treatment of, 23, 334.
Confidence, blind of Eastern peoples, 9.
Congenital conditions, frequency of, 378.
Conjunctiva, cysts of, 309.
essential shrinking of, 310.
foreign bodies in, 324.
Herbert's cyst-formation in, 310.
in beriberi, 407, 412.
obliteration of fornices, 295, 310, 435.
pigmentation of, 365.
staining of, 500, 506.
tears of, 324.
Conjunctival adhesions, symptoms of, 309.
bridges and pouches, 307, 309.
disease, epidemics of, 15.
papule, 322.
pockets, 308.
Conjunctival sac, introduction of irritants into, 14, 21, 23, 334.
introduction of septic substances into, 24.
Conjunctivitis, due to ultra-violet light, 36.
electric, 43.
Conjunctivitis, filarial, 321.
glare, 49–51.
gonococcal, 24.
in dysentery, 420, 421, 422.
in smallpox, 481, 482.
in trypanosomiasis, 488, 489.
in typhus, 492.
larval, 194, 195.
Parinaud's, 312, 313.
peculiarities in Tropics, 309.
phlyctenular, 293.
post-choleraic, 418.
post-operative, 280.
retro-tarsal, 39.
Samoan, 314, 315.
yellow-moth, 126.
Consanguinity, 75.
Cordylobia anthropophaga, 193.
Cornea, exposure of, in disease, 333, 416, 481, 482.
in beriberi, 407, 412.
lead incrustation of, 336.
leucoma, due to smallpox, 483.
septic ulcer of, 16, 337, 338, 348, 350, 352, 357, 360, 361.
upper marginal pitting of, 304.
Corneal complications of diseases, 296, 425.
plaques, Herbert's, 333-335.
ulcers, examination of scrapings from, 208.
Cosmetic pot, Eastern, 112, 300.
Couched lens, detection of, 234.
reascension of, 240.
removal of, 237, 238.
Couched nucleus, 229, 241.
Couchers, Indian, classes of, 222, 224.
fees of, 223, 224.
filthy methods of, 216, 233, 238.
habits of, 222.
headquarters of, 222.
methods of deception by, 223.
mistakes in diagnosis by, 224, 225.
status of, 224.
surgical equipment of, 219, 223.
Couching, 14, 28, 215–241.
accidental injuries attending, 230.
anæsthesia in, 224.
anterior operation, 218, 240.
causes of failure after, 227.
chambers of the eye in, 229, 230, 234, 236, 237.
description of, by Mackenzie, 215.
diagnosis of, 233–238.
in absence of fundus reflex, 236.
in complete dislocation, 233–236.
in incomplete dislocation, 236.
in presence of occluded pupil, 236.
dislocation of lens through retina, 230, 240.

Couching, education of public against, 224, 228.
element of magic in, 225.
forward dislocation of lens in, 229, 240.
glaucoma after, 227, 232.
hereditary trade of, 222.
imperfect dislocation of cataract in, 227, 236.
introduction into Europe, 215.
native literature of, 222.
of Morgagnian cataract, 240.
pain following, 239.
pathology of, 229.
patients' histories unreliable, 233, 236, 237.
posterior operation, 219, 240.
scars left by, 234.
statistics of, 226.
surgical opinion of, 216, 226, 233.
technique of, 218.
visual results after, 226.
Cow-horn injuries, 324.
Cracker feasts, 29.
Crookes' glass, 45, 92.
Crow, Indian, 401.
Customs, native, 402.
Cyanopsia, 67, 87, 88, 89.
Cycloplegia, 419, 467, 501, 503.
Cysticercus, 153.
Cysts, conjunctival, due to insects, 138.

Daboia elegans (Russell's Viper), 143, 144.
Dacruocystitis, conservative methods of treatment, 353.
phlegmonous, 348, 350, 352, 353, 357, 359.
Dark adaptation, in beriberi, 410.
Dazzling from coloboma, 370.
in erythropsia, 90, 91.
in sun-blindness, 71.
Debility, tropical, 446.
Demodex folliculorum, 145.
Dengue, 501.
diagnosis from yellow fever, 501.
Dental sepsis, 15, 387, 388, 392, 447.
Depression of cataract, 215, 239.
Dermatobia cyanoventris, 196.
hominis, 189.
Diabetes, 388, 502.
dangers of cataract extraction in, 502.
urine in, 502.
Diabetic retinitis, 502.
Dibothriocephalus latus, 154.
Diet before operation, 6.
Diet, influence of, on disease, 18.
Dioptric media, absorption of light by, 36.
Diphtheria, ocular, 338.
Diptera, 187.
Distichiasis, 295, 299.
Distoma ringeri, 152.
Domestic remedies, 15,19, 27.
Dressings, sterilisation of, 254.
Dropper bottles, sterilisation of, 254.
Drugs, indigenous, 10.
Dust, 95, 96, 97, 99, 108, 446, 453.
Dysentery, 419–428.
ætiology of eye affections in, 426.
amœbic, 419, 424, 426.
bacillary, 420, 421, 422, 424, 426.
choroiditis in, 425.
conjunctivitis in, 420, 421, 422.
corneal complications in, 425.
incidence of uveitis in, 422.
irido-cyclitis in, 420, 422, 424, 425.
literature of eye complications of, 419.
optic neuritis in, 390, 425.
pathology of eye affections in, 426.
prognosis of eye affections in, 427.
relapses of uveitis in, 424, 427.
retino-choroiditis in, 392.
rôle of intestinal lesion in, 427.
rôle of staphylococci and streptococci in eye affections of, 426.
syndrome, 419, 420, 421, 422, 425, 426, 427.
treatment by sera, 426.
treatment of eye complications, 427.

East and West, ignorance of view points, 398.
Eastern standard of work, 396.
Echinococcus of orbit, 153.
Echis venom, 144.
Eclipse blindness, 37, 58, 62.
European experience of, 73.
immunity of children, 64.
prophylaxis, 72.
treatment, 72.
Ectropion, 296, 434.
Eel's blood conjunctivitis, 132.
serum, hæmolysis by, 132.
Electric ophthalmia, 49, 60.
Electrolysis of hairs, 299.
Electrolytic action of lightning, 53.
Elephantiasis of lids, 159.
Elliot's cruet, for sterilising drops, 255.
dissector, 355.
evisceration spoon, 340.
neurectomy hook, 374.
tea-pot irrigator, 256.
tray for irrigation, 256.

Enteric fever, 503.
Entropion, 295, 434.
Eosinophilia, 168, 318, 389, 391.
Epidemic dropsy, 414.
  glaucoma in, 414.
  relation of beriberi to, 414.
Epidemic ophthalmia, 108–114.
    ætiology, 108–113.
    native carelessness in dealing with, 113.
    need of personal cleanliness in, 113.
    organisms responsible for, 108–110.
    seasonal prevalence of, 109, 110.
Epiphora, 352, 434.
Erythropsia, 58, 67, 87, 89.
  control eye in, 91, 92.
  in aphakia, 90.
  researches in, 91.
  treatment, 91.
Euphorbia, 122, 127.
Evisceration of eye, 339.
  spoon, 340.
Excision of eyeball, dangers of, 339.
    prejudice against, 373.
Exenteration of orbit, 380.
  hæmorrhage in, 380, 382.
Expert, the amateur village, 20.
Explosive, dangerous form of, 29.
Exposure to solar rays, 41.
Extirpation of lachrymal sac. *Vide* lachrymal sac.
Eye preparations, native, ingredients of, 21.
Eyeflies, 118, 122, 129.
Eyelid edges, sterilisation of, 252.
Eyelids, amyloid degeneration of, 346.
  attacks by insects on, 145.
  myxomatous degeneration of, 346.
  Samoan disease of, 315.
  tears of, 324.
  thickened conditions of, 346.
Eye-strain in Tropics, 394.

Facial expression of terrified patients, 249.
Feeding of patients, 7, 399.
Ferrety eyes of yellow fever, 506.
Field of projection, 249.
Filamentary keratitis, 331.
Filaria bancrofti, 158.
  diurna, 161.
  equina, 173, 174.
  frequency of, in animal eyes, 173.
  inermis, 171.
  in eyelid, 171.
  in man, 174.
Filaria bancrofti, loa, 161.
  oculi humani, 173.
  under conjunctiva, 171.
Filariæ, difficulty in identifying species of, 150.
Filariidæ, 157.
Filtering cicatrix, dangers of insect stings in, 135.
Fish, eating of raw, 154.
  lice, 145.
  parasites of, 146.
Fistula of cornea, 230.
Flies, breeding grounds of, 129, 300.
  habits of, 192.
  house, 122, 129, 187, 300.
  larvæ of, 192.
  rôle of, in epidemic ophthalmia, 111, 112.
Fluorescin, 326, 327, 329.
Foerster's operation, 57.
Food-stuffs of the country, 399.
Foreign bodies in conjunctiva, 324.
Fowl's blood, use of by coucher, 221, 223.
Fowls, eyes pecked by, 142.
Friends of patients, 8.
Fruits, acid, 385.
Fu, or fumuski blennorrhœa, 126, 127.
Fundus diseases, ætiology of, in Tropics, 387.

Glare, 99, 446, 453, 504.
  asthenopia, ætiology of, 40.
    cause of pain in, 42.
    clinical course of, 38.
    curative treatment of, 44.
    mental effects of, 39, 40.
    prophylaxis of, 45.
  avoidance of, 47.
  conjunctivitis, 49–51.
  forms of, 50, 67.
Glass, Crookes', 45, 92.
  neutral tint, 92.
  uviol, 92.
Glassblowers' cataract, 287.
Glaucoma, 58, 367–376.
  acute and subacute, 368.
  ætiology of, 372.
  diagnosis of, in Tropics, 369.
  disadvantages of iridectomy in Tropics, 370.
  following couching, 227, 232.
  prophylactic operations for, 370.
  relative frequency of, in Tropics, 367.
  secondary to cataract, 370.
  statistics of, 371.
  treatment of, 372.

Glaucoma, trephining in, 372, 373.
types of, in Tropics, 367.
Goggles, motor, 96.
sun, 46, 51.
Gold-fly, 188.
Gonorrhœal ophthalmia, 340.
Government policy toward medical services, 4, 451.
Granuloma, subconjunctival, 341–345.
ætiology of, 342.
pathology of, 345.
progress of, 341.
treatment of, 345.
Green bug, 117, 124.
Guaiacol in leprosy, 441.

Hæmorrhage during extirpation of lachrymal sac, 357, 358.
during exenteration of orbit, 380, 382.
in optico-ciliary neurectomy, 375.
retinal. *Vide* retinal.
Heat, 95, 99, 446.
exhaustion, 503.
rays, action of, on eyes, 54.
Heatstroke, 503.
Helminthiasis, 388, 391.
Hemianopsia, 68.
Henle's glands, 309.
Herbert's corneal plaques. *Vide* corneal plaques.
disease, 326.
sign of trachoma, 306.
Herpes corneæ, 453.
Horoscopes, 9.
Hospital management, 395, 399.
meal times, 397.
staff, 396, 402.
Hospitals, Indian, 396.
crow-proof, 401.
formal inspections of, 400.
organisation of, 251, 395.
surprise visits to, 397.
Hyaloid artery mistaken for parasite, 175.
Hypermature cataracts, 16.
Hypoderma bovis, 176, 189, 196, 197.

Ignorance of the people, 113, 368, 369.
Inbreeding, 378, 387, 389.
Indigenous drugs, 10.
Infra-red rays, 35.
Injuries of eyes
at night, 350.
by flying insects, 121, 124, 125, 192.
by lightning, 52.
by plant hairs, 126.
chemical, 130.
occupational, 350, 353.
Insect agency, septic infection by, 129, 136.
Insects flying, 97, 121–123.
chemical injuries by, 121, 124.
infection by, 121, 127.
injuries by hairs of, 125.
mechanical injuries by, 121, 122.
nocturnal, 123, 192.
Instruments for couching, 219, 223.
Intestinal sepsis, 387, 388.
Intra-capsular operation, 263.
advantages claimed for, 263.
objections to, 263.
Intractable patients, 249.
Invertebrata, classification of, 151.
Irido-cyclitis, 30, 56, 134, 419, 420, 422, 424, 425, 486, 488, 489, 505.
Iris shadow, 246.
Irrigation fluid, tray for, 256.
of eye before operation, 255.
Irrigations, magnesium sulphate, 340.
perchloride, 252, 331, 337.
Irrigator, M'Keown's, 256.
simple, 257.
tea-pot, 256.
Ixodidæ, 138.

Japanese blood fluke, 152.
Jassidæ, 124.
Jigger. *Vide* chigger.

Kakke, 405–414.
in the newborn, 412, 414.
Keratitis, filamentary, 331, 332.
in leprosy, 436, 437.
in malaria, 452–454.
interstitial, in leprosy, 437.
in malaria, 453.
profunda, 454.
punctata onchocercosa, 178, 179, 330.
superficial (malarial), 452.
punctate (Herbert's disease), 326, 327.
in leprosy, 437.
(Kirkpatrick's disease), 328–330.
(Westhoff's disease), 327, 328.
Keratomalacia, 79, 81, 84.
Keratomycosis, 208.
Kirkpatrick's disease, 328–330.
Krause's glands, 309.
Kuhnt's excision of tarsus, 298.

Laboratory, the village, 20.
Lachrymal fistula, 350, 357, 359.
gland, tumours of, 378, 380.

Lachrymal fistula, obstruction, 16, 348–361
ætiology of, 348, 349.
dangers of, 348.
Madras statistics of, 348.
operations for, 350.
pathology of, 348, 349.
prevalence of, in the East, 348.
statistics of, 349.
passages, test for patency of, 248, 359.
sac, extirpation of, 348, 352–361.
cautery in, 356.
complications after, 360.
complications before, 357.
complications during, 358.
difficulties of, 358.
examination of parts removed, 356.
hæmorrhage attending, 357, 358.
opening of lachrymal groove, 355, 358.
position of table, 354.
recurrence of retention after, 360.
skin incision, 355.
steps of operation, 354–356.
Lagophthalmus, 416, 494.
Lamp-shades, 47.
Languages, knowledge of native, 5, 12, 250, 395, 402.
Larvæ, 193.
Larval skin disease, 195.
Late stage of cases, 8, 16, 368, 369, 377, 380.
Lead incrustation of cornea, 336.
Leeches, attacks on conjunctiva by, 140.
Lens, absorption of solar rays by, 36.
filariæ in, 175.
fluorescence of, 36.
Leontiasis, 431.
Lepromata, 436.
Leprosy, 429–444.
adnexa of eye in, 431.
bacteriology of, 440.
cataract in, 439.
clinical course of eye symptoms in, 430.
conjunctiva and cornea in, 436.
course of, 429.
dangers to eye from, 435–438.
date of involvement of eye in, 430.
direct inoculation in, 440.
ectropion and entropion in, 434.
epiphora in, 434.
frequency of eye affections in, 429, 430.
fundus changes in, 439.
Leprosy, infection in, 440.
iris and ciliary body in, 438.
keratitis in, 437.
lachrymation in, 435.
lymphatic glands in, 440.
muscle palsies in, 434, 435.
nerve, 431, 437.
nodular, 431, 436.
operations in, 442.
prognosis in, 437.
prophylaxis in, 442.
rashes in, 429.
spontaneous cure of, 442.
treatment of, 441.
visual fields in, 440.
Leucoma, tattooing of, 336, 483.
Lid control, Smith's, 275.
Lid operations, native, 27.
Light adaptation, 370.
Light, as a cause of cataract, 285, 287.
physical properties of bright, 35.
Lightning, disruptive action of, 54.
injuries of eyes by, 52, 55–60.
stroke, 53.
Loa loa, 161–170, 488.
absence of embryos in blood, 168.
anatomical characteristics, 164.
attraction to surface of skin by warmth, 167.
development of embryos, 161.
differences in African and European patients, 168.
duration in human beings, 162.
ear symptoms due to, 166.
endemic area of, 161.
eosinophilia in, 168.
hemiplegia from, 168.
movements of, in body of host, 166.
precautions in removal of, 167.
rate of movements, in human body, 167.
removal of, 169.
sexual maturation of, 162.
symptoms due to, 165.
treatment of, 168–170.
London School of Tropical Medicine, 150, 172.
Louse, pubic, 145.
Lucilia hominivorax, 195.
Lucky days and hours, 251, 402.
Luminous rays, action of, on eyes, 53.
Lung-fluke, 152.

McAll's disease, 341.
Macaw-worm, 189.
McReynolds' operation, 104.
Macula, hole in, 69.
pigmentation around, 387.

Madras cataract bandage, 260.
Madura-foot disease, 207.
Magnesium sulphate irrigation, 340.
Malaria, 445–460.
  ætiology of eye complications of, 458.
  amaurosis in, 456, 459.
  anæmia in, 456.
  benign tertian, 449.
  cachexia in, 452, 456.
  conjunctiva in, 451.
  cornea in, 452.
  frequency of eye complications in, 448.
  hæmolysis in, 450.
  intra-ocular hæmorrhages in, 449, 455, 456.
  keratitis in, 448, 452, 453, 454.
  malignant tertian, 450.
  masked, 457.
  neuralgia in, 452, 457.
  ocular signs of, 451.
  optic neuritis in, 455, 457.
  paralysis of eye muscles in, 458.
  pathology of ocular complications in, 453.
  pernicious symptoms in, 450.
  petechial hæmorrhages in, 451.
  pigments in, 450, 451, 452.
  quartan, 449.
  quotidian, 450.
  retino-choroiditis in, 392.
  tests for, 445.
  treatment of eye symptoms, 459.
  types of, 449.
  uveal tract in, 454, 455.
Malignant disease, 16, 377.
Malingering, 140, 331, 334.
Mamoti, 20.
Mangrove fly, 161.
Marginal ring ulceration, 304.
Mental attitude of peoples, 9.
Metamorphopsia, 67, 71.
Mickulicz's disease, 380.
Microfilaria diurna, 168.
  nocturna, 158.
  sanguinis equi, 174.
Micron, 35.
Micropsia, 67.
Milk-hedge plant, 122.
Missing links in knowledge, 291.
Mites, 119, 120.
Morgagnian fluid, irritating nature of, 241.
Mosquitoes, 118, 136, 187.
Murmekiasmosis amphilaphes, 210.
Muscidæ, 188, 191, 193.
Mycetoma, 207.
Myiasis, 191–198, 377.
  clinical course of, 193.
Myiasis, conditions influencing, 191.
  intra-ocular, 176, 189, 196, 197.
  mild cases, 193.
  severe cases, 195.
  treatment of, 197.
Myopia among savage peoples, 384.

Nasal canal, racial peculiarities of, 366.
Native practitioner, unqualified, 14, 19–28.
Necator americanus, 157, 183.
Nemathelminthes, 157.
Nematodes, 157.
Neutral tint glass, 92.
New growths of eyeball and adnexa, 377–382.
Night-blindness, 67, 75–85, 183, 186, 410, 474, 493.
  epidemic, 75.
  famine, a cause of, 76.
  history of, 76.
  idiopathic, 75.
  pupillary reflex in, 84.
  signs and symptoms of, 76–80.
  test for feigning of, 83.
  treatment of, 84.
Nocturnal animals, 142.
  insects. *Vide* insects.
Nyctalopia. *Vide* night-blindness.
Nystagmus, quinine, 467.

Object of the book, 291.
Obliquity of eye, Mongolian, 365.
Œdema of lids, 488, 505, 506.
Œstridæ, 188, 191, 194.
Omens, 402.
Onchocerciasis, 178.
Operative procedures, native, 27.
Ophthalmia, epidemics of, 108.
  nodosa, 125, 126.
Ophthalmic hospitals in Tropics, need of, 4, 5, 367, 368.
Ophthalmoscopic appearances in dark-skinned races, 365, 387–394.
Opposition to Western practice, 14.
Optic atrophy, 58, 389, 390, 411, 419, 457, 474, 490, 494, 495.
  neuritis, 390, 412, 425, 455, 457, 494, 503.
Optico-ciliary neurectomy, 373–376.
  hook, 373.
  neurotomy, 376.
Optogram of sun, 65.
Organisation of hospitals, 251, 395.

Palpebral fissure, dust in, 96, 99.
Pannus, 296, 302.
  carnosus, 304.

Pannus, ulceration, 304.
Panophthalmitis, 17, 337, 338, 339, 340, 348.
Papillo-macular bundle, atrophy of, 69, 407, 411.
Paralysis, facial, in thelaziasis, 180.
Parasites, misleading descriptions of, 149.
Pareses and paralyses of ocular muscles, 58, 59, 407, 411, 458, 467, 474, 494, 501.
Parinaud's conjunctivitis. *Vide* conjunctivitis.
Patients' friends, 8.
Patients, human sympathy with native, 250.
Patriarchal system, 112.
Pearly sectored cataract, 247.
Peculiarities of tropical practice, 3.
Pellagra, 473–475.
  action of maize in, 473.
  allied to the toxic psychoses, 473.
  distinctive features of, 473.
  eye signs of, 474.
  insect borne, 474.
  juvenile cataract in, 474
  prognosis of, 474.
  protozoal disease, 474.
  seasonal prevalence of, 473.
  visual field in, 474.
Perchloride irrigation, 252, 331, 337.
Perimetry, difficulties of, in Tropics, 369.
Peritomy, 300.
Phasmidæ, 125.
Phlyctenular conjunctivitis. *Vide* conjunctivitis.
Phlyctenules, bulbar, 293.
  palpebral, 294.
Phthisis bulbi after couching, 237.
Pigmentation of retina, 391.
Pinguecula, 99, 100.
Pioneer work, 12.
Plague, 333, 476–480.
  choroiditis in, 476, 479.
  cornea in, 478.
  diminution of tension in, 477.
  direct inoculation of, 478.
  facies of, 476.
  hæmorrhages in, 477.
  iritis and irido-cyclitis in, 478.
  ophthalmic complications of, 476.
  pathology of, 479.
  prophylaxis neglected, 478.
  scleral ectasiæ in, 477.
  treatment of, 477.
Plant hairs, 126, 127.
Poisonous arthropods, 139.
Poisons, care of, 401.
Porto Rico, 137.
Poverty of the peoples, 6, 368.
Press propaganda, 72, 73.
Prevalence of eye disease in Tropics, 14.
Preventable blindness, 4.
Primary optic atrophy, 389.
Prophylactic operations, 8.
Psychology of Eastern patients, 261, 262.
Pterygium, 96, 100–107, 159, 435.
  cysts in, 104.
  double, 103, 106.
  excision of, 104.
  false, 100.
  growth of, 103.
  invasion of pupillary area by, 102.
  limitations of eye movements by, 101.
  malignant, 103.
  pathology of, 103.
  progressive, 101.
  transplantation of, 104, 106.
  treatment of, 104.
  vascular, in typhus, 492.
Ptosis, 412.

Quinine blindness, 464–467.
    course of attack, 464.
    duration of, 465.
    method of onset of, 464, 465.
    restoration of sight after, 465.
Quinine content of blood, 462.
  dangerous doses of, 461.
  dangers and advantages weighed, 461.
  dangers in children, 467.
  idiosyncrasy of patient, 462.
  massive doses of, 461.
  method of administration, 462.
  precautions in administering, 463.
  repetition of doses of, 463.
  solubility of salt employed, 462.
  total amount retained, 462.
  toxic doses of, 463.
  vehicle of administration of, 462.
Quinine poisoning, 75, 80, 447, 457, 459, 461–472.
    alterations of light sense in, 465.
    aural symptoms in, 467.
    colour vision in, 466.
    general symptoms in, 467.
    general treatment of, 470.
    influence of age and sex in, 463.
    ischæmia in, 466, 468.
    medical treatment of, 469.
    mydriasis in, 466.
    operative treatment of, 470.
    ophthalmoscopic changes in, 466 467.

Quinine poisoning, paralysis of ocular muscles in, 467.
pathology of, 467–469.
visual fields in, 465, 466.

Railway facilities, 5, 368, 370.
Rats, 142.
Realgar, 29.
Reclination of cataract, 215, 239.
Recurrent fever, 505.
typhus, 505.
Refraction errors, 17, 383–386, 394.
work in Tropics, 384, 385.
Refusal of operative treatment, 377.
Relapsing fever, 505.
Religious rite of sun-gazing, 63.
Research, field for, 18.
Responsibilities of the Empire, medical, 4.
Retina, action of solar rays on, 37.
Retinal dazzling, 64.
hæmorrhages, 58, 69, 184, 392, 449, 455.
solar erythema, 64.
veins, broken blood column in, 417, 466.
Retinitis exudative, 392.
hæmorrhagic, 392.
in leprosy, 439.
in trypanosomiasis, 489.
pigmentosa, 75, 389, 390, 391.
solar, 68.
Retino-choroiditis, 391, 392.
Retrobulbar neuritis, 185, 407.
Rhinosporidium kinealyi, 200–206.
characteristic appearance of, 204.
nasal, 200.
ocular, 200.
of lachrymal sac, 204.
operation for, 202, 205.
pathology of, 202, 205.
pore in cysts, 204.
quinine, treatment of, 206.
transmission of, 204.
Rodents, 142.
Roller forceps, 297.

Saffron-coloured rag, the, 113.
Salvarsan, 499.
Samoa, filariasis in, 158.
Samoan conjunctivitis, 314.
eyelid disease, 315.
Sand-flea, 145.
Sand-fly fever, 505.
Sarcophagidæ, 188, 189, 191, 195.
Scoiinophora vermiculata, 126.
Scorpions, 119, 120, 139.
Scotoma for colours, 410.
from sun-blinding, 63, 65.
heli-eclipticum, 64.
Scotoma, in beriberi, 407.
oscillatory, 66, 67, 72.
pestle-shaped, 409.
ring, 66, 67.
Screw-worms, 188.
Seasons, influence of the, 7.
Secondary optic atrophy, 389.
Self-hypnotism, 393.
Sepsis, dangers of, in East, 337.
Shrinkage of the eye after couching, 237.
Sierra Leone, 145, 161.
Simuliidæ, 474.
Sinuous lid border, 306, 333.
Siphonella funicula, 122.
Siriasis, 503, 504.
diagnosis from cerebro-spinal fever, 504.
Size of tumours, large, 377.
Skin, iodine sterilisation of, 252.
tumours of onchocerciasis, 178.
Sleep, injury by insects during, 137.
injury by rodents, etc., during, 142.
Smallpox, 334, 481–484.
a cause of blindness, 482.
conjunctivitis in, 481, 482.
eruption on conjunctiva and lids, 482.
late complications, 483.
neglect of patients in, 481, 482.
prevalence of, in Tropics, 481.
prophylaxis of, 483.
treatment of, 483.
Snake-bite, eye-symptoms in, 143.
hæmorrhages in, 144.
ptosis in, 143.
pupils in, 144.
Snakes, colubrine, 143.
tree, 142, 143.
viperine, 143.
Snow-blindness, 49, 90.
Soamin, 490.
Solar retinitis, 64, 68.
after-images in, 70.
animal experiments on, 69, 70.
European experience of, 73.
ophthalmoscopic appearances in, 68, 69.
physical conditions in, 69, 70.
prognosis in, 71.
prophylaxis of, 72.
treatment of, 72.
Sparganum mansoni, 154.
Sparganosis, ocular, 155.
Specimens, identification of zoological, 150, 171, 172, 179, 190.
preservation of zoological, 150, 172, 190.
Spectacles, provision of, 385.
Spectrum, 35.

Spiders, 119, 120, 139.
Spirillum obermeieri, 505.
Sponge fishers, 50.
Spring catarrh, 316–320.
bulbar form of, 317.
diagnosis of, 318, 319.
eosinophilia in, 318.
symptoms of, 316.
tarsal form of, 316.
treatment of, 320.
Squint operations, 17.
Staff, menial, of hospitals, 11.
training of hospital, 251, 254.
Staphylococcus infection, 385.
Staphyloma of cornea, 25.
Steriliser, alcohol, 258.
Stick-insects, 125.
Streatfield's operation, modified, 298.
Strongylidæ, 157.
Styes, 386.
Subretinal filaria, 176.
maggot, 176, 197.
Sun-blinding, macular lesion in, 393.
Sun-gazing, 63, 393.
Sunstroke through eyes, 504.
Sun-traumatism, 504.
Superstition, 9.
Suspicion of foreign agencies, 12.
Swabs, mounted, 255.
Sympathetic ophthalmia after couching, 232.
Syphilis, 387, 391.

Tape-worms, 153, 154.
Tartar emetic, 490.
Telegraph and telephone operators, 59.
Teratoma of orbit, 378.
Termes bucephalus, 137.
fatalis, 137.
Test-types for illiterate, 369.
Tetanus, 338.
Thelaziasis, canine, 180.
human, 180.
in other animals, 182.
symptoms of, 180.
Thrips, 125.
Thymol, 186.
Thysanoptera, 125.
Ticks, 118, 138.
Tonometry, mechanical, 369.
Toti's operation, 352.
Trachoma, 16, 295–306, 347.
blindness due to, 295.
complications of, 295, 296, 302
cure of, 295.
Herbert's sign of, 306.
mixed infections in, 295.
neglected, 295.
perchloride treatment of, 298.
Trachoma, prevalence of, in South India, 349.
prophylaxis of, 300.
results of, 302, 333.
stages of, 295.
treatment of, 297.
Tree snakes, 142.
Trematodes, 152.
Tremulous iris, 234.
Trichiasis, 295, 299.
Trivalin hyoscin, 253.
Tropical relapsing fever, 505.
Trypanosomes in blood, 486.
in tissues, 487.
method of staining of, 487.
Trypanosomiasis, 485–491.
conjunctiva in, 486.
cornea in, 487.
date of appearance of eye signs in, 486, 487, 489.
experiments on animals, 485.
eye lesions in man, 488.
hæmorrhages in anterior chamber, 487, 489.
in animals, 486.
iris in, 487.
irido-cyclitis in, 486.
keratitis in, 485, 488.
retinitis in, 489.
signs of, 486.
treatment of, 488, 490.
Tumbu-fly, 188.
Typhus, 492–496.
alopecia in, 493.
cataract in, 493.
complications of convalescence, 494.
complications of febrile period, 493.
conjunctivitis in, 492.
corneal ulcers in, 495.
early slight symptoms of, 492.
ecchymosis in, 492, 494.
eyelid scars following, 495.
fundus changes in, 494.
iris in, 493.
night-blindness in, 493.
orbital phlegmon in, 495.
optic atrophy in, 494, 495.
palpebral abscess in, 494.
photophobia in, 493.
pupil in, 493.
treatment of ocular complications, 495.

Ultra-violet rays, 35.
action of, on eye, 49, 52, 54.
Undulant fever, 506.
Unqualified native practitioners, 14, 19, 27.

Urine of mother, as eye-wash, 24.
Urine, virgin's, 24.
Uveitis, 16.
Uviol glass, 92.

Vaccinia of lid edges, 484.
Valuables, storage of patients', 400.
Venereal disease, 15, 387, 389, 392, 447.
Viperine snakes, 143.
Virgin's urine, 24.
Visual fields in beriberi, 407, 409, 410.
in leprosy, 440.
in night-blindness, 79.
in pellagra, 474.
in quinine poisoning, 465, 466.
Vitreous body, after couching, 230, 237.
filariæ in, 175.
injury of, by lightning, 57.
opacities in, 67, 417.

Ward-boys, 396.
Warts, multiple cutaneous, 212.
Wasps, 118, 133.
Wassermann reaction in leprosy, 441.
Western practitioners, opposition to, 14, 238.
Westhoff's disease, 327.
West's operation, 352.
White ants, 400.
Wind, 95, 96, 99, 108, 446, 453.
Woman, 13, 19.

Xerosis of conjunctiva and cornea, 77, 293, 296, 311, 410, 435.
causes of, 81.
complications of, 79, 293, 294.
hæmoglobin content in, 79, 80, 82.
influence of light in, 82, 83.
ophthalmoscopic appearances in, 80.
pathology of, 80.
Xerosis of other mucous membranes, 78.

Yaws, 159, 497–499.
alopecia in, 498.
eruption of, 497.
iritis in, 498.
treatment of, 499.
Yellow fever, 501, 506.
amaurosis in, 506.
hæmorrhages in, 506.
late manifestations of, 506.
staining of conjunctivæ in, 506.
Yellow-moth, 126.
Yellow vision in beriberi, 410.
Yogi practices, 393, 394.

Ziegler's knife, 283.
Zoological specimens, identification of, 150, 171, 172, 179, 190.
preservation of, 150, 172, 190.

INDEX OF NAMES

Adler, 471.
Alcock, A., 125, 127, 128, 190, 198.
Allbutt and Rolleston, 459.
Alport, 450, 456, 459, 461, 464, 471.
Aoki, T., 406, 409, 412, 414.
Arboleda, 443.
Arboleda and Manrique, 443.
Argyll-Robertson, D., 170.
Aristotle, 64.
Arlt, 48, 454.
Ashford, B. K., 184, 186.
Ask, F., 65, 73.
Axenfeld, T., 85, 440, 443.
Ayres, S. C., 55, 60.

Baer, C., 133, 134, 135.
Bahr, P. *Vide* Manson-Bahr.
Ballantyne, A. J., 471.
Barabashew, P., 471.
Bardelli, L., 331, 332.
Barkan, H., 501.
Basso, 349.
Beattie, J. M., 204, 206.
Beauvois, A., 64, 66, 68.
Behr, C., 51.
Behse, T., 471.
Bell, L., 51.
Berger, E., 471, 496.
Best, F., 85, 91, 92.
Betti, L., 192, 198.
Bettin, R., 146.
Bietti, 185, 186.
Birch-Hirschfeld, A., 60, 65, 68, 69, 70, 72, 471.
Birt, 505.
Bitot, 76, 85.
Black, M., 73.
Blanchard, 171.
Boehm, K., 62, 64, 68.
Boldt, J., 300.
Borthen, L., 430, 443.
Boulai, J., 196, 198.
Bourland, 457, 459.
Braunschweig, 73, 83, 85.
Breda, A., 443, 499.
Browne, E. A., 471.
Browning, S. H., 420, 427.
Bruck, E., 482, 484.
Bruder, J., 63, 69, 73.
Brunetière, 170.
Bruns, H. D., 471.
Buchanan, W. J., 76, 85.
Bull and Hanson, 443.
Buller, F., 471.
Butler, T. H., 135.

Cabaut, A. B., 153, 154.
Cabaut, J. A., 170.
Calderado, 443.
Calendoli, S., 443.
Calhoun, A. W., 471.
Calhoun, F. P., 184, 186, 475.
Calmette and Salambeni, 479.
Cantlie, J., 476, 478, 479.
Cargill, L. V., 471.
Carpenter, G., 503.
Casali, A., 63, 67, 68, 69, 73.
Casalicchio, 194, 198.
Casaux, J., 155, 156.
Castellani and Chalmers, 170, 499, 505.
Celsus, 215, 216.
Chalmers and Christopherson, 210, 212.
Champeaux, P., 414.
Chance, B., 430, 443.
Chiarini and Fortunati, 443.
Chipman, E. D., 440, 443.
Claiborne, J. H., 66, 74, 471.
Clarke, A. B., 475.
Cleland, J. B., 156.
Coats, G., 349.
Coburn, E. B., 140, 141.
Collins, E. T., 51, 58, 60, 66, 67, 74, 108, 114, 443, 491.
Conner, L. A., 471.
Coppez, H., 175, 177, 410, 414.
Cords, R., 66, 68, 69, 74.
Cosmettatos, G. F., 69, 74, 138.
Cosse and Delord, 421, 427.
Coste, 417.
Coullaud, 60.
Crookes, Sir W., 45, 51,

Daniels, C. W., 414, 485, 489, 490, 491.
Danielssen and Boeck, 443.
Danis, M., 79, 84, 85.
Dantrelle, A., 492, 496.
Dantrelle, A., and Mlle. Leonida, 496.
Darling, C. J., 486, 491.
Darling, S. T., 186.
Da Silva Lama, 411, 414.
Davis, W. T., 459.
De Bono, T. P., 471.
De Bouffon, 64.
De Britto, 376.
Dehogues, 79, 82, 85.
De Hubbenet, 76, 85.
Demaria, 153, 154.
De Milly, 170.
De Ridder, P., 51.
De Schweinitz, G. E., 60, 126, 128, 146, 443, 460, 471, 487.
De Schweinitz, G. E., and Woods, A. C., 491.
De Silva, W. H., 430, 440, 443.
Dopter, 496.
Dor, L., 56, 60.
Dorff, H., 131.
Doutrelepont and Wolters, 443.
Doyne, R. W., 313, 502.
Drake-Brockman, E. F., 124, 216, 217.
Drake-Brockman, H. E., 216, 217, 221, 223.
Drake-Brockman, R. E., 505.
Drualt, 471.
Duane, A., 146.
Dunlap, C. B., 73, 75.

Ekambaram, R., 221, 222, 225.
Ellett, E. C., 60.
Elliot, R. H., 31, 48, 51, 63, 92, 144, 170, 194, 198, 215, 217, 221, 228, 232, 336, 361, 376, 418, 471.
Elliot, R. H., and Ingram, A. C., 200, 206, 382.
Ely, C. F., 314, 315.
Enslin, E., 88, 92.
Espada, J, 443.

Fano, 175, 177.
Farmakouski, N. V., 193, 198.
Feilchenfeld, W., 84, 85, 471.
Ferentinos, Sp., 68, 74.
Fernandez, J. S., 175, 177, 443.
Fiessinger and Leroy, 420, 427.
Fink, L. G., 501.
Forbes, J. G., 172.
Fox, L. Webster, 471.
Franke, 66, 69.
Franke and Delbanco, 443.
Fraser, Sir T. R., 144.
Fuchs, E., 60, 443, 460.
Fugita, 409.
Fulleborn, 170.

Gabrielides, 443.
Galen, 64.
Gallenga, 138.
Garrod, Sir A. E., 419, 425, 427.
Garrow, A., 506.
Gibson, F. L., 460.
Gillemeau, 64.
Gimlette, J. D., 471.
Glogner, M., 414.
Golowin, 376.
Gonin, 51, 60.
Graham, G., 422, 428.
Grossmann, K., 443.
Gruening, E., 471.
Grunberg, 197.
Guichemerre, P., 134, 135.
Guzmann, E., 195, 198.

Hajano, 208, 209.
Hallauer, 85.
Hart, 443.
Hepburn, M. L., 80.
Herbert, H., 85, 293, 294, 298, 300, 302, 303, 304, 305, 306, 307, 309, 318, 319, 320, 322, 323, 330, 333, 334, 335, 336.
Herford, 170.
Hertel, 349.
Hess, C., 60, 79, 85, 89, 92, 197, 198.
Heymans, 443.
Hilbert, R., 58, 60, 133, 135.
Hoffman, 64.
Holden, W., 471.
Hollman, H. T., 443.
Holst, A., 414.
Honeij, 435, 443.
Houdart, E., 419, 426, 428.
Houghton, H. S., 180, 182.
Huffman, O. V., 170.
Hunald, G., 133, 134, 135.
Huseman, 471.

Ichihara, N., 406, 409, 411, 412, 414.
Inouye, 185, 186.
Ishihara, S., 76, 82, 85.
Ishizu, 411, 412.

Jacks, 84, 85.
Jackson, E., 151, 172, 321.
Jeanselme and Morax, 441, 443.
Jeanselme, E., and Rist, E., 499.

Jellett, J., 491.
Jellinck, S., 55, 60.
Jervey, J. W., 186.
Jess, A., 66, 74.
Jodko, 471.
Joseph, 418.

Kagoshima, 407.
Kahut, 176, 177.
Kalebiakin, A. T., 471.
Karnitsky and Weinstein, 443.
Kaurin, 430.
Kerr, T. S., 486.
Kiep, W. H., 422, 423, 424, 426, 427, 428, 452.
Kipp, 452,
Kirk, J., 448, 457, 458.
Kirkpatrick, H., 51, 63, 69, 74, 204, 206, 217, 284, 328, 330, 340, 349, 365, 387, 425, 428, 443, 448, 471.
Knapp, A., 460.
Knapp, H., 471.
Knapp, P., 58, 60.
Koch, 490.
Komoto, J., 407.
Komoto, J., and Aoki, T., 407, 410, 414.
Kono, 414.
Koun, 85.
Kraupa, E., 133, 135.
Kuwahara, Y., 140, 141.

Lagleyze, P., 195, 198.
Lakah and Khouri, 109, 114.
Landolt, 85.
Lane, J. E., 443.
Laveran, A., 485.
Laveran, A., and Mesnil, F., 491.
Leber, A., 158, 160, 177.
Leiper, R. T., 161, 170, 180, 182.
Le Roux, 56, 58, 61.
Levrier, 454.
Levy, 80.
Lewis, T. R., 160.
Lie, 438.
Lingard, A., 174, 177.
Lopez, E., 175, 177, 430, 440, 443.
Lorenz, W. F., 473, 475.
Low, G. C., 168, 170.
Lucretius, 64.
Luna Pacheco, 179, 330.
Luna, R. P., 424.
Lundsgaard, K. K. K., 73, 74.

McAll, P. L., 341, 345.
McCallan, A. F., 109, 114, 300.
Macdonald, E. A., 170.
McGregor, H. J., 500, 501.
Mackay, G., 197, 198.
Mackenzie, W., 215, 217.
McMullen, 51, 92.
McReynolds, 104.
Manolescu, 471.
Manson, Sir P., 154, 156, 170, 198, 209, 411, 414, 430, 440, 444, 445, 460, 475, 491, 501, 504, 505.
Manson-Bahr, P., 112, 114, 156, 158, 160, 174, 177, 179.
Markan, 174, 177.
Markus, 126, 127.
Markwald, 420.
Marshall, F. H. A., 143.
Marubi, 414.
Maxwell, E. M., 422, 426, 427, 428, 452, 457, 460.
Maxwell, E. M., and Kiep, W. H., 428.
Maynard, F. P., 216, 217, 414, 476, 479.
Mayou, M. S., 81, 85.
Meinhof, H., 170.
Meller, J., 437, 444.
Menacho, 74.
Meyerhof, 76, 109, 110, 112, 114.
Mikamo, 80, 85.
Miura, K., 415.
Miyashita, 405, 410, 411, 412, 413, 415.
Montgomery, D. W., 431, 444.
Morax, V., 420, 428.
Morgan, J. C., 61.
Mori, M., 76, 85.
Morrisey, 444.
Morrow, H., and Lee, A. W., 430, 444.
Mould, Major, 80, 85.
Moure, P., and Sorrel, E., 496.
Müller, 479.
Munro, A. C., 502.

Nakamura, B., 410, 411.
Neisser, 444.
Netter, 496.
Nettleship, E., 80, 471.
Neve, A., 430, 439, 444.
Neves da Rocha, 170.
Newmann and Lingard, 174.
Noble, C. P., 502.
Nuel, 460.

Oblath, 132.
Orendorff, 133, 135.
Osler, Sir W., 170, 420, 428, 444, 484, 502, 503, 505, 507.
Osler and Macrae, 428.
Othchapovski, 444.
Ottolenghi, 475.
Oyenard, 145, 146.

Pace, Angelo, 171, 172

Parinaud, 313.
Parker F. J., 471
Parker and Haswell, 157.
Parsons, J. H., 35, 51, 61, 81, 85, 126, 128, 174, 177, 313, 444, 479.
Pascheff, C., 496.
Pergens, 69, 74.
Perrin and Poncet, 460.
Petit, 170.
Pollock, C. F., 439, 444.
Poncet, 448, 455, 460.
Pridmore and Coats, 174, 177.
Procopui, Geo., 475.
Purtscher, O., 133, 135.

Quadri, 175.

Raehlmann, 145.
Railliet, A., 182.
Railliet and Henry, 182.
Raizis, G. S., 444.
Rauensbusch, 170.
Rees, D. C., 480.
Rees, P., 480.
Reina, 471.
Reis, W., 195, 198.
Renaud, 56, 58, 61.
Rivers, W. H. R., 386.
Roberts, S. R., 475.
Robertson, A., 170.
Rochat, 170.
Roche, C., 444, 484.
Rochon-Duvigneaud, 134, 135.
Rogers, W., 170.
Römer, 478, 480.
Roosa and Ely, 472.
Roth, F., 170.
Ross, E. H., 114.
Roy, J. N., 386.
Ruata, G. R., 127, 128, 137, 145, 146, 192.
Ruhemann, J., 47, 51, 85.

Sabongy, S., 482, 484.
Saint-Yves, 64.
Sakaguchi, 126, 128.
Salambeni, 478.
Salle, 420.
Sambon, L. W., 473, 475, 497.
Sands, T. L., 444.
Santos Fernandez, J., 51, 74, 416, 418, 502, 506, 507.
Sauvineau and Morax, 444.
Schaube, B., 170.
Schiele, A., 76, 81, 84, 86.
Schikano, 444.
Schirmer, 444.
Schöler, 175, 177.
Schwabe, G., 472.
Seto, 132.
Shipley, A. E., 157, 190.
Shipley and MacBride, 151, 157
Smith, H., 216, 217.
Smith, H. Edgar, 455, 456, 460.
Speleers, 66.
Spiller, W. A., 473, 475.
Stanzeale, R., 444.
Stephens, J. W. W., and Fantham, H. B., 486, 491.
Stephenson, S., 76, 79, 81, 82, 86, 503.
Stitt, E. R., 198, 411, 415, 429, 430, 438, 444, 507.
Stook, 69, 74.
Stratford, H. M., 313.
Streiff, J., 483, 484.
Stricker, 70.
Stuckey, E. J., 180, 182.
Sym, W. J., 89, 92.

Takashima, S., 126, 127, 128, 132.
Taylor, J. F., 112, 114.
Terlinck, 69, 74.
Terrien, F., and Prelat, P., 164, 170.
Thoinot, 496.
Thomas and Linton, 485.
Thomas and Parsons, 196, 198.
Thompstone, S. W., 170.
Thomson, F. W., 114.
Tirumurti, 204, 206.
Tooke, 349.
Topolanski, 61.
Trantas, 439, 444.
Trimble, C. J., 180, 182.
Tshizu, 409.
Tsurumaru, 407, 410, 415.
Tucker, 475.
Tucker, R. B., 475.
Tyson, 65, 67, 74.
Tyson, H. H., 472.

Uhthoff, W., 68, 74, 457.
Upshur, 472.

Vail, D., 170.
Valada, 171.
Valois, 58, 61.
Valois and Lemoine, 69, 74.
Verhaeghe, D., 61
Verhœff, F. H., 51.
Verhœff, F. H., and Bell, L., 70. 74, 91.
Villard, 65, 66, 67, 69, 74.
Vincent et Muratet, 496.
Vinsonneau, 68, 74, 503.
Vogt, A., 90, 92.
Von Græfe, 417, 418, 472.
Von Herrenschwand, 79, 80, 86, 92.
Von Hippel, 86.
Von Marenholtz, F., 58, 61,

Von Reuss, 92.
Vossius, A., 427, 428.

Wahba, A., 193, 198.
Walker, C. B., 51, 74.
Ward, H. B., 145, 146, 151, 152, 186.
Ware, J., 215, 217.
Weekers, L., 86.
Weeks, J. E., 472.
Weir Mitchell, S., 59, 61.
Welton, C. B., 475.
Werdenburg, E. F., 64, 65, 68, 72, 74.
Westhoff, C., 327, 330.
Whaley, E. M., 475.
Wibo, 69, 74.
Widmarck, 287.
Williams, 418.
Williams, E., 472.
Wood, 472, 504.
Wright, H., 411, 415.
Wydler, V., 70, 74, 91, 92.

Xenophon, 64.

Yamagiwa, 480.
Yamaguchi, H., 409, 411, 412, 415.
Yamamoto, Y., 406, 407, 410, 412, 415.
Yarr, M. T., 58, 61, 170, 171, 172, 176, 177, 457, 460.
Yoshida, S., 156.
Youdine, 476, 479, 480.
Yudkin, 438, 444.

Zade, M., 66, 67, 74.
Ziegler, S. L., 284.

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